

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

MILHENCH, Howard, L.
R.G.C. Jenkins & Co.
26 Caxton Street
London SW1H 0RJ
ROYAUME-UNI

Date of mailing (day/month/year)
12 March 2001 (12.03.01)

Applicant's or agent's file reference

IMPORTANT NOTIFICATION

International application No.
PCT/GB00/01204

International filing date (day/month/year)
29 March 2000 (29.03.00)

1. The following indications appeared on record concerning:

the applicant the inventor the agent the common representative

Name and Address
MURGITROYD & COMPANY
373 Scotland Street
Glasgow G5 8QA
United Kingdom

State of Nationality	State of Residence
Telephone No. 0141 307 8400	
Facsimile No. 0141 307 8401	
Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

the person the name the address the nationality the residence

Name and Address
MILHENCH, Howard, L.
R.G.C. Jenkins & Co.
26 Caxton Street
London SW1H 0RJ
United Kingdom

State of Nationality	State of Residence
Telephone No. +44 (0)20 7931 7141	
Facsimile No. +44 (0)20 7222 4660	
Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

<input checked="" type="checkbox"/> the receiving Office	<input type="checkbox"/> the designated Offices concerned
<input type="checkbox"/> the International Searching Authority	<input checked="" type="checkbox"/> the elected Offices concerned
<input checked="" type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Authorized officer

Dominique DELMAS

Facsimile No.: (41-22) 740.14.35

Telephone No.: (41-22) 338.83.38

THIS PAGE BLANK (USPTO)

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

MILHENCH, Howard, L.
R.G.C. Jenkins & Co.
26 Caxton Street
London SW1H 0RJ
ROYAUME-UNI

Date of mailing (day/month/year) 12 March 2001 (12.03.01)	
Applicant's or agent's file reference	IMPORTANT NOTIFICATION
International application No. PCT/GB00/01204	International filing date (day/month/year) 29 March 2000 (29.03.00)

1. The following indications appeared on record concerning: <input checked="" type="checkbox"/> the applicant <input type="checkbox"/> the inventor <input type="checkbox"/> the agent <input type="checkbox"/> the common representative				
Name and Address BUCHANAN, Nigel Beechtree Cottage New Gilston Fife KY8 5TF United Kingdom	State of Nationality		State of Residence	
	GB		GB	
	Telephone No.			
	Facsimile No.			
Name and Address SMART TOOLS LIMITED Beech Tree Cottage New Gilston, By Leven Fife KY8 5TF United Kingdom	Telephone No.			
	Facsimile No.			
	Teleprinter No.			
2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning: <input checked="" type="checkbox"/> the person <input checked="" type="checkbox"/> the name <input checked="" type="checkbox"/> the address <input type="checkbox"/> the nationality <input type="checkbox"/> the residence				
Name and Address SMART TOOLS LIMITED Beech Tree Cottage New Gilston, By Leven Fife KY8 5TF United Kingdom	State of Nationality		State of Residence	
	GB		GB	
	Telephone No.			
	Facsimile No.			
Name and Address SMART TOOLS LIMITED Beech Tree Cottage New Gilston, By Leven Fife KY8 5TF United Kingdom	Facsimile No.			
	Teleprinter No.			

3. Further observations, if necessary: The applicant identified in Box No.1 is to be considered as applicant/inventor for the purposes of US only, since he assigned his rights for all designated States except US to a new applicant as indicated below.				
--	--	--	--	--

4. A copy of this notification has been sent to: <input checked="" type="checkbox"/> the receiving Office <input type="checkbox"/> the designated Offices concerned <input type="checkbox"/> the International Searching Authority <input checked="" type="checkbox"/> the elected Offices concerned <input checked="" type="checkbox"/> the International Preliminary Examining Authority <input type="checkbox"/> other:				
---	--	--	--	--

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Dominique DELMAS Telephone No.: (41-22) 338.83.38
---	--

THIS PAGE BLANK (USPTO)

PATENT COOPERATION TREATY

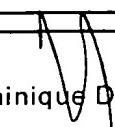
PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

Date of mailing (day/month/year) 12 March 2001 (12.03.01)	From the INTERNATIONAL BUREAU To: MILHENCH, Howard, L. R.G.C. Jenkins & Co. 26 Caxton Street London SW1H 0RJ ROYAUME-UNI
Applicant's or agent's file reference J43114wo	R. G. C. JENKINS & CO. ★ 13 MAR 2001 ★ CHARTERED PATENT AGENTS
International application No. PCT/GB00/01204	IMPORTANT NOTIFICATION International filing date (day/month/year) 29 March 2000 (29.03.00)

1. The following indications appeared on record concerning:				
<input checked="" type="checkbox"/> the applicant <input type="checkbox"/> the inventor <input type="checkbox"/> the agent <input type="checkbox"/> the common representative				
Name and Address BUCHANAN, Nigel Beechtree Cottage New Gilston Fife KY8 5TF United Kingdom	State of Nationality GB		State of Residence GB	
	Telephone No.			
	Facsimile No.			
	Teleprinter No.			
2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:				
<input type="checkbox"/> the person <input checked="" type="checkbox"/> the name <input checked="" type="checkbox"/> the address <input type="checkbox"/> the nationality <input type="checkbox"/> the residence				
Name and Address SMART TOOLS LIMITED Beech Tree Cottage New Gilston, By Leven Fife KY8 5TF United Kingdom	State of Nationality GB		State of Residence GB	
	Telephone No.			
	Facsimile No.			
	Teleprinter No.			
3. Further observations, if necessary: The applicant identified in Box No.1 is to be considered as applicant/inventor for the purposes of US only, since he assigned his rights for all designated States except US to a new applicant as indicated below.				
4. A copy of this notification has been sent to:				
<input checked="" type="checkbox"/> the receiving Office <input type="checkbox"/> the International Searching Authority <input checked="" type="checkbox"/> the International Preliminary Examining Authority		<input type="checkbox"/> the designated Offices concerned <input checked="" type="checkbox"/> the elected Offices concerned <input type="checkbox"/> other:		

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer  Dominique DELMAS Telephone No.: (41-22) 338.83.38
---	---

THIS PAGE BLANK (USPTO)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P25749A/LBA/SBL/JCO	FOR FURTHER ACTION		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/GB00/01204	International filing date (day/month/year) 29/03/2000	Priority date (day/month/year) 29/03/1999	
International Patent Classification (IPC) or national classification and IPC B25B13/52			
Applicant BUCHANAN, Nigel			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p><input type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input checked="" type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application 			

Date of submission of the demand 17/10/2000	Date of completion of this report 28.06.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Jeggy, T Telephone No. +49 89 2399 7341

THIS PAGE BLANK (USPTO)

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/01204

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-22 as originally filed

Claims, No.:

1-22 as originally filed

Drawings, sheets:

1/12-12/12 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description, pages:
- the claims, Nos.:

THIS PAGE BLANK (USPTO)

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/01204

the drawings, sheets:

5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N) Yes: Claims 5, 7, 13-14, 16, 19-22
 No: Claims 1-4, 6, 8-12, 15, 17-18

Inventive step (IS) Yes: Claims
 No: Claims 1-22

Industrial applicability (IA) Yes: Claims 1-22
 No: Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

THIS PAGE BLANK (USPTO)

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

V.1 Cited documents

Reference is made to the following documents :

- D1 : US-A-4 967 612 (R.SPARLING) 6 November 1990 (1990-11-06)
- D2 : US-A-2 435 329 (D.M.STAINPROOK) 3 February 1948 (1948-02-03)
- D3 : DE 16 03 767 A (DAIMLER-BENZ AG) 18 February 1971 (1971-02-18)
- D4 : US-A-1 464 128 (L.COES) 7 August 1923 (1923-08-07)
- D5 : US-A-1 666 353 (A.C.SCHELF) 17 April 1928 (1928-04-17)
- D6 : GB 235 434 A (A.I.MANCHO) 9 July 1925 (1925-07-09)
- D7 : US-A-1 610 387 (J.E.PENNINGTON) 14 December 1926 (1926-12-14)

V.2 Claims 1-22

The document D1 discloses (the references in parentheses applying to this document) a wrench having a head portion (27) adapted to engage and apply torque to a workpiece (11, Figure 1 ; Column 1, lines 6-8), said head portion (27) including a flexible ring portion (27) having an inner working surface (29) for engaging the workpiece (11, Figure 1) such that, when a torque is applied to said head (27) in a predetermined direction (33), said ring portion (27) closes around said workpiece (11 ; Column 3, lines 8-45 and more particularly lines 17-21 and 37-45)

The subject-matter of claim 1 is therefore not new (Article 33 (2) PCT).

Note that the subject-matter of claim 1 is also disclosed in D2 (Figure 1 ; Column 1, line 50 - Column 2, line 34), D3 (Figure 1 ; page 3 last paragraph) and in D4 (Figures 1-4 ; page 2, lines 13-33).

Dependent claims 2-4, 6, 8-12, 15 and 17-18 do not contain any features which, in combination with the features of any claim to which they refer, meet the require-

THIS PAGE BLANK (USPTO)

ments of the PCT in respect of novelty (Article 33 (2) PCT), the reasons being as follows :

- Cl 2-4 : see D1, with cam surface 24. See also D2 with a convex cam surface 21. See also D4 only for claim 2
- Cl 6 : see D1, Figures 1, 3 and D2, Figure 1
- Cl 8-10 : see D1, Figure 1. See also D2, Figure 1 and D3, Figure 1 for a generally polygonal convex inner surface of the ring member (1, 2)
- Cl 11-12 : see D1, Figure 1 with reduced segments F-K (Figure 3)
- Cl 15 : see D3, Figure 1 and D4, Figure 1
- Cl 17-18 : see D1, Figure 1 with pivot 28. See also D2, Figure 1 with plurality of segments 17 and D3 with pivot 4

Dependent claims 5, 7, 13-14, 16 and 19-22 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step (Article 33 (3) PCT), the reasons being as follows :

- Cl 5 : One of the several possibilities given to the skilled person to increase the cooperation between the two contacting surfaces of a cam system
- Cl 7 : One of the several possibilities given to the skilled person to increase locally the hardness of a contacting point so that the efficiency of the cam system is increased
- Cl 13-14 : well-known constructions for the gripping parts in the technical field of wrenches to improve the contacts between the nut, bolt or screw and the head portions
- Cl 16 : One of the several possibilities given to the skilled person to allow the use of such a wrench in two opposite directions
- Cl 19 : see D6, Figures 1 and 3 with spring J
- Cl 20-22 : see D5, Figure 1 with flexible member A, segments 5, 6, yoke part defined by plates 13 (page 1, line 94 - page 2, line 2). Further features of claims 21-22 are just one of the several possibilities the skilled person would use with involving an inventive step to define such a wrench (see also D6, Figures 1 and 3 and D7, Figure 1)

THIS PAGE BLANK (USPTO)

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/01204

Re Item VII

Certain defects in the international application

VII.1 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 and D5 is not mentioned in the description, nor are these documents identified therein.

VII.2 Independent claim 1 is not in the two-part form in accordance with Rule 6 (3) (b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6 (3) (b) (i) PCT) and with the remaining features being included in the characterising part (Rule 6 (3) (b) (ii) PCT).

VII.3 The features of the claims are not provided with reference signs placed in parentheses (Rule 6 (2) (b) PCT).

THIS PAGE BLANK (USPTO)

PCT

14

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P25749A/LBA/SBL/JCO	FOR FURTHER ACTION		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/GB00/01204	International filing date (day/month/year) 29/03/2000	Priority date (day/month/year) 29/03/1999	
International Patent Classification (IPC) or national classification and IPC B25B13/52			
Applicant [BUCHANAN, Nigel] SMART TOOLS LIMITED			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I Basis of the report
- II Priority
- III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV Lack of unity of invention
- V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI Certain documents cited
- VII Certain defects in the international application
- VIII Certain observations on the international application

Date of submission of the demand 17/10/2000	Date of completion of this report 28.06.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Jeggy, T Telephone No. +49 89 2399 7341



THIS PAGE BLANK (USPTO)

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/01204

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):
Description, pages:

1-22 as originally filed

Claims, No.:

1-22 as originally filed

Drawings, sheets:

1/12-12/12 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description, pages:
- the claims, Nos.: ,

THIS PAGE BLANK (USPTO)

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/01204

- the drawings, sheets:
5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)): *(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*
6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 5, 7, 13-14, 16, 19-22
	No:	Claims 1-4, 6, 8-12, 15, 17-18
Inventive step (IS)	Yes:	Claims
	No:	Claims 1-22
Industrial applicability (IA)	Yes:	Claims 1-22
	No:	Claims

**2. Citations and explanations
see separate sheet**

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

THIS PAGE BLANK (USPTO)

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/01204

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

V.1 Cited documents

Reference is made to the following documents :

- D1 : US-A-4 967 612 (R.SPARLING) 6 November 1990 (1990-11-06)
- D2 : US-A-2 435 329 (D.M.STAINPROOK) 3 February 1948 (1948-02-03)
- D3 : DE 16 03 767 A (DAIMLER-BENZ AG) 18 February 1971 (1971-02-18)
- D4 : US-A-1 464 128 (L.COES) 7 August 1923 (1923-08-07)
- D5 : US-A-1 666 353 (A.C.SCHELF) 17 April 1928 (1928-04-17)
- D6 : GB 235 434 A (A.I.MANCHO) 9 July 1925 (1925-07-09)
- D7 : US-A-1 610 387 (J.E.PENNINGTON) 14 December 1926 (1926-12-14)

V.2 Claims 1-22

The document D1 discloses (the references in parentheses applying to this document) a wrench having a head portion (27) adapted to engage and apply torque to a workpiece (11, Figure 1 ; Column 1, lines 6-8), said head portion (27) including a flexible ring portion (27) having an inner working surface (29) for engaging the workpiece (11, Figure 1) such that, when a torque is applied to said head (27) in a predetermined direction (33), said ring portion (27) closes around said workpiece (11 ; Column 3, lines 8-45 and more particularly lines 17-21 and 37-45)

The subject-matter of claim 1 is therefore not new (Article 33 (2) PCT).

Note that the subject-matter of claim 1 is also disclosed in D2 (Figure 1 ; Column 1, line 50 - Column 2, line 34), D3 (Figure 1 ; page 3 last paragraph) and in D4 (Figures 1-4 ; page 2, lines 13-33).

Dependent claims 2-4, 6, 8-12, 15 and 17-18 do not contain any features which, in combination with the features of any claim to which they refer, meet the require-

THIS PAGE BLANK (USPTO)

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/01204

ments of the PCT in respect of novelty (Article 33 (2) PCT), the reasons being as follows :

- CI 2-4 : see D1, with cam surface 24. See also D2 with a convex cam surface 21. See also D4 only for claim 2
- CI 6 : see D1, Figures 1, 3 and D2, Figure 1
- CI 8-10 : see D1, Figure 1. See also D2, Figure 1 and D3, Figure 1 for a generally polygonal convex inner surface of the ring member (1, 2)
- CI 11-12 : see D1, Figure 1 with reduced segments F-K (Figure 3)
- CI 15 : see D3, Figure 1 and D4, Figure 1
- CI 17-18 : see D1, Figure 1 with pivot 28. See also D2, Figure 1 with plurality of segments 17 and D3 with pivot 4

Dependent claims 5, 7, 13-14, 16 and 19-22 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step (Article 33 (3) PCT), the reasons being as follows :

- CI 5 : One of the several possibilities given to the skilled person to increase the cooperation between the two contacting surfaces of a cam system
- CI 7 : One of the several possibilities given to the skilled person to increase locally the hardness of a contacting point so that the efficiency of the cam system is increased
- CI 13-14 : well-known constructions for the gripping parts in the technical field of wrenches to improve the contacts between the nut, bolt or screw and the head portions
- CI 16 : One of the several possibilities given to the skilled person to allow the use of such a wrench in two opposite directions
- CI 19 : see D6, Figures 1 and 3 with spring J
- CI 20-22 : see D5, Figure 1 with flexible member A, segments 5, 6, yoke part defined by plates 13 (page 1, line 94 - page 2, line 2). Further features of claims 21-22 are just one of the several possibilities the skilled person would use with involving an inventive step to define such a wrench (see also D6, Figures 1 and 3 and D7, Figure 1)

THIS PAGE BLANK (USPTO)

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/01204

Re Item VII

Certain defects in the international application

- VII.1 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 and D5 is not mentioned in the description, nor are these documents identified therein.
- VII.2 Independent claim 1 is not in the two-part form in accordance with Rule 6 (3) (b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6 (3) (b) (i) PCT) and with the remaining features being included in the characterising part (Rule 6 (3) (b) (ii) PCT).
- VII.3 The features of the claims are not provided with reference signs placed in parentheses (Rule 6 (2) (b) PCT).

THIS PAGE BLANK (150701)

INTERNATIONAL SEARCH REPORT

Int'l. Application No

PCT/GB 00/01204

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B25B13/52 B25B13/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B25B B67B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 967 612 A (R.SPARLING) 6 November 1990 (1990-11-06) column 3, line 8 - line 29; claim 1; figures ---	1-3,6,8, 9,11,12, 17
X	US 2 435 329 A (D.M.STAINPROOK) 3 February 1948 (1948-02-03) column 1, line 50 -column 2, line 34; figure 1 ---	1-4,6,8, 17,18
X	DE 16 03 767 A (DAIMLER-BENZ AG) 18 February 1971 (1971-02-18) figure 1 ---	1,2,8-10
X	US 1 464 128 A (L.COES) 7 August 1923 (1923-08-07) claims; figures ---	1,2
	-/-	

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 July 2000	20/07/2000
Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Majerus, H

THIS PAGE BLANK (USPTO)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/01204

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4967612	A	06-11-1990	NONE	
US 2435329	A	03-02-1948	NONE	
DE 1603767	A	18-02-1971	NONE	
US 1464128	A	07-08-1923	NONE	
US 1666353	A	17-04-1928	NONE	
GB 235434	A		NONE	
US 1610387	A	14-12-1926	NONE	

THIS PAGE BLANK (USPTO)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No.	International filing date (day/month/year)	(Earliest) Priority Date (day/month/year)
PCT/GB 00/01204	29/03/2000	29/03/1999
Applicant		
BUCHANAN, Nigel		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

- the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :
- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. **Certain claims were found unsearchable (See Box I).**

3. **Unity of Invention is lacking (see Box II).**

4. With regard to the **title**,

- the text is approved as submitted by the applicant.
- the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

- the text is approved as submitted by the applicant.
- the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

- as suggested by the applicant.
- because the applicant failed to suggest a figure.
- because this figure better characterizes the invention.

1

None of the figures.

THIS PAGE BLANK (USPTO)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/GB 00/01204

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

LINE 2 - ...DELETE '(SUCH AS A NUT, BOLT OR SCREW)'
LINES 10 TO 25 - ...DELETE COMPLETELY

THIS PAGE BLANK (USPTO)

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 00/01204

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B25B13/52 B25B13/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B25B B67B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 967 612 A (R.SPARLING) 6 November 1990 (1990-11-06) column 3, line 8 - line 29; claim 1; figures ---	1-3,6,8, 9,11,12, 17
X	US 2 435 329 A (D.M.STAINPROOK) 3 February 1948 (1948-02-03) column 1, line 50 -column 2, line 34; figure 1 ---	1-4,6,8, 17,18
X	DE 16 03 767 A (DAIMLER-BENZ AG) 18 February 1971 (1971-02-18) figure 1 ---	1,2,8-10
X	US 1 464 128 A (L.COES) 7 August 1923 (1923-08-07) claims; figures ---	1,2 -/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

12 July 2000

Date of mailing of the international search report

20/07/2000

Name and mailing address of the ISA:

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Majerus, H

THIS PAGE BLANK (USPTO)

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/01204

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 1 666 353 A (A.C.SCHELF) 17 April 1928 (1928-04-17) page 1, line 94 -page 2, line 2; figure 1 ---	14,20,21
A	GB 235 434 A (A.I.MANCHO) 9 July 1925 (1925-07-09) page 1, line 55 - line 65; figure 1 ---	19
A	US 1 610 387 A (J.E.PENNINGTON) 14 December 1926 (1926-12-14) page 1, line 73 - line 77; figure 1 -----	14,20

THIS PAGE BLANK (USPTO)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/01204

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4967612	A	06-11-1990	NONE	
US 2435329	A	03-02-1948	NONE	
DE 1603767	A	18-02-1971	NONE	
US 1464128	A	07-08-1923	NONE	
US 1666353	A	17-04-1928	NONE	
GB 235434	A		NONE	
US 1610387	A	14-12-1926	NONE	

THIS PAGE BLANK (USPTO)



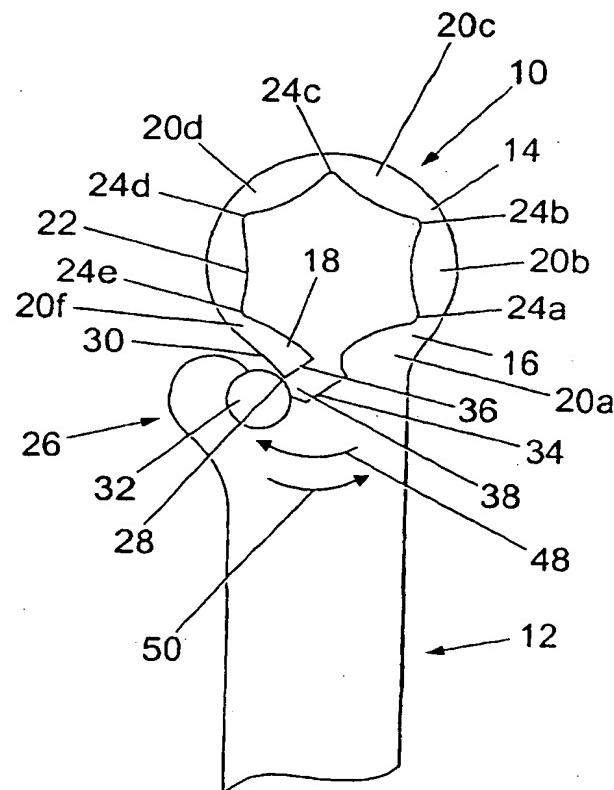
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : B25B 13/52, 13/04	A1	(11) International Publication Number: WO 00/58057 (43) International Publication Date: 5 October 2000 (05.10.00)
(21) International Application Number: PCT/GB00/01204		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
(22) International Filing Date: 29 March 2000 (29.03.00)		
(30) Priority Data: 9907059.1 29 March 1999 (29.03.99) GB		
(71)(72) Applicant and Inventor: BUCHANAN, Nigel [GB/GB]; Beechtree Cottage, New Gilston, Fife KY8 5TF (GB).		
(74) Agent: MURGITROYD & COMPANY; 373 Scotland Street, Glasgow G5 8QA (GB).		
Published <i>With international search report.</i>		

(54) Title: WRENCH

(57) Abstract

A wrench has a head portion (10) adapted to engage and apply torque to a workpiece, including a ring member (14) which surrounds the workpiece and has a fixed end (16) and a free end (18) such that, when the ring engages a workpiece and a torque is applied in a predetermined direction (48), the ring closes around the workpiece, increasing the grip between the wrench and the workpiece even if the workpiece is substantially worn, damaged or undersized.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Larvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		

1 Wrench

2

3 The present invention relates to wrenches (also known
4 as "spanners", particularly in the United Kingdom), and
5 in particular to "ring" wrenches.

6

7 A wrench is a tool for applying torque to a nut, bolt,
8 screw or the like (hereinafter referred to, for
9 convenience, as a "workpiece") for the purpose of
10 tightening or slackening the workpiece. The wrench has
11 a head portion shaped to engage the periphery of the
12 workpiece in a non-rotatable manner such that a force
13 applied to rotate the head transmits torque to the
14 workpiece. The workpiece generally has a polygonal
15 shape, typically hexagonal or square, and the head of
16 the wrench has a complementary shape and size. The head
17 of a ring wrench is configured to substantially
18 surround the periphery of the workpiece.

19

20 The following description will refer particularly to
21 wrenches for use with hexagonal nuts. However, it will
22 be understood that the invention is equally applicable

1 to wrenches and corresponding nuts having other shapes
2 and to other types of workpiece such as bolts and
3 screws.

4

5 A conventional ring wrench has a ring-shaped head with
6 a hexagonally shaped inside surface, each section of
7 which is substantially flat. In use, the flat surfaces
8 and corners on the inner surface of the head engage the
9 flat surfaces and corners of the nut to be tightened or
10 slackened. When the head is rotated in the appropriate
11 direction the nut is slackened or tightened as
12 required. However if the nut is undersized, damaged or
13 worn, it is very likely that the head will 'slip' and
14 rotate around the nut instead of properly gripping or
15 engaging the flats and corners of the nut.

16

17 It is an object of the present invention to provide an
18 improved wrench with which workpieces that are
19 undersized, damaged or worn can be reliably engaged by
20 the wrench for applying a torque thereto.

21

22 In accordance with the invention there is provided a
23 wrench having a head portion adapted to engage and
24 apply torque to a workpiece, said head portion
25 including a flexible ring portion having an inner
26 working surface for engaging the workpiece, such that,
27 when a torque is applied to said head in a
28 predetermined direction, said ring portion closes
29 around said workpiece.

30

31

1 Preferably, said head portion is adapted to engage and
2 apply torque to a workpiece, said head portion
3 including a ring member adapted to substantially
4 surround a peripheral surface of a workpiece and having
5 a first, fixed end and a second, free end such that,
6 when an inner surface of said ring member engages a
7 workpiece and a torque is applied to said head portion
8 in a predetermined direction, said ring member closes
9 around said workpiece.

10

11 Preferably, said wrench further includes a first cam
12 surface disposed adjacent an outer surface of a free
13 end portion of said ring such that, when said inner
14 surface of said ring member engages said workpiece and
15 said torque is applied to said head portion in said
16 predetermined direction, said first cam surface presses
17 against said outer surface of said free end portion of
18 said ring.

19

20 Preferably also, said first cam surface is generally
21 convex.

22

23 Preferably also, said outer surface of said free end
24 portion is generally concave.

25

26 Optionally, said first cam surface is formed integrally
27 with said wrench or said first cam surface is provided
28 by an insert.

29

30 Preferably, said ring member comprises a plurality of
31 segments.

32

1 Preferably also, said segments define a generally
2 polygonal inner surface of said ring member.

3

4 Preferably also, each of said segments has an inner
5 surface which is generally convex in the
6 circumferential direction of said ring member.

7

8 Preferably, at least some of said segments are formed
9 integrally with one another and said ring member is
10 adapted to deform resiliently at junctions between
11 adjacent, integrally formed segments.

12

13 Preferably also, said junctions between adjacent,
14 integrally formed rings have a reduced thickness in the
15 radial direction as compared with the remainder of said
16 segments.

17

18 Preferably also, said junctions comprise portions of
19 the inner surface of said ring member which are
20 generally concave in the circumferential direction of
21 said ring member.

22

23 Optionally, the inner surface of said ring member is
24 corrugated.

25

26 Preferably, said head portion includes means for
27 limiting movement of said free end of said ring member
28 relative to said fixed end thereof in said
29 predetermined direction.

30

31 Preferably, said head portion includes means for
32 limiting movement of said free end of said ring member

1 relative to said fixed end thereof in a direction
2 opposite to said predetermined direction.
3

4 Preferably, said head portion includes hinge means
5 whereby at least a portion of said ring member may be
6 pivoted in the plane of said ring member relative to
7 the remainder of said head portion.
8

9 Preferably also, said ring member comprises a plurality
10 of segments and said hinge means is located between at
11 least one pair of adjacent segments.
12

13 Preferably also, the wrench includes resilient bias
14 means associated with said hinge means and adapted to
15 bias said ring member towards a closed position.
16

17 In an alternative embodiment, ring portion is pivotably
18 connected to a yoke portion of said head and comprises
19 a plurality of segments interconnected by an elongate
20 flexible member having first and second free ends
21 secured to said yoke portion such that pivoting
22 movement of said ring relative to said yoke in a
23 predetermined direction causes a length of said
24 elongate flexible member passing around said ring to be
25 shortened and the ring to close.
26

27 Preferably, first and second segments of said ring are
28 formed integrally with one another as part of a pivot
29 member pivotably mounted in said yoke by means of a
30 pivot pin and the remainder of said segments are formed
31 as discrete members, said flexible elongate member
32 being threaded through said remainder of said segments

1 and the free ends thereof passing around an outer
2 surface of said pivot member and around said pivot pin.
3

4 Preferably also, the first free end of the flexible
5 elongate member extends from one of said discrete
6 segments, passes around one part of said outer surface
7 of said pivot member opposite an inner surface thereof
8 defining a first segment, over the top of, around and
9 under the pivot pin, and out of the front of the yoke
10 portion, and wherein the second free end of the elongate
11 flexible member extends from another of said
12 discrete segments, passes around a second part of said
13 outer surface of the pivot member opposite an inner
14 surface thereof defining a second segment, under the
15 first free end and the pivot pin, and out of the front
16 of the yoke portion.

17

18 Embodiments of the invention will now be described, by
19 way of example only, with reference to the accompanying
20 drawings in which:

21

22 Fig. 1 is a front elevation of a head portion of a
23 first embodiment of a wrench in accordance with the
24 present invention;

25

26 Figs. 2a, 2b and 2c are front elevations of examples of
27 dual-head wrenches of different sizes in accordance
28 with the embodiment of Fig. 1;

29

30 Fig. 3a illustrates in perspective the wrench of Fig. 1
31 gripping a worn nut and Fig. 3b shows a perspective view
32 of the worn nut of Fig. 3a;

1

2 Fig. 4a is a front elevation of a head portion of a
3 second embodiment of a wrench in accordance with the
4 present invention, and Fig. 4b is an end elevation the
5 wrench of Fig. 4a;

6

7 Fig. 5 is a front elevation of a head portion of a
8 third embodiment of a wrench in accordance with the
9 present invention;

10

11 Figs. 6a-6d are front elevations of a head portion of a
12 fourth embodiment of a wrench in accordance with the
13 present invention in which head is hinged, Fig. 6a
14 showing the head in its working position and Figs. 6b,
15 6c and 6d showing the head rotated by different angles
16 about the hinge;

17

18 Fig. 7 is a front elevation of the head portion of a
19 fifth embodiment of a wrench in accordance with the
20 present invention in which the head is hinged;

21

22 Fig. 8 is a front elevation of the head portion of a
23 sixth embodiment of a wrench in accordance with the
24 present invention in which the head is hinged, and in
25 which the hinge is provided by a ball and socket joint;

26

27 Fig. 9 is a front elevation of the head portion of a
28 seventh embodiment of a wrench in accordance with
29 the present invention in which the head is hinged, and
30 in which the hinge is provided by a knuckle joint;

31

1 Figs. 10a-10c are front elevations of the head portion
2 of an eighth embodiment of a wrench in accordance with
3 the present invention, in which the head is hinged, Fig
4 10c showing the head in its working position and Figs.
5 10a and 10b showing the head in fully and partially
6 open positions;

7

8 Figs. 11a and 11b are front elevations of the head
9 portion of a ninth embodiment of a wrench in accordance
10 with the present invention in which the head includes
11 multiple hinges, Fig.11a showing the head in its
12 working position and Fig. 11b showing the head in an
13 open position, and Fig.11c is a side elevation the
14 wrench of Fig.11a;

15

16 Figs. 12a-12e are front elevations of the head portion
17 of tenth embodiment of a wrench in accordance with the
18 present invention, in which the head is hinged by means
19 of a chain link interconnecting two portions of the
20 head, Fig. 12a showing the head in its working position
21 and Figs. 12b-12e showing the head rotated by different
22 angles about the hinge, and Figs. 12f-12h are
23 perspective views illustrating the chain link of Figs.
24 12a-12e;

25

26 Figs. 13a and 13b are front elevations of the head
27 portion of an eleventh embodiment of a wrench in
28 accordance with the invention, in which the head is
29 hinged by means of a chain link and incorporating
30 resilient bias means, and Fig. 13c is a front elevation
31 of a chain link incorporating integral resilient bias
32 elements;

1

2 Fig. 14 is a front elevation of the head portion of a
3 twelfth embodiment of a wrench in accordance with the
4 present invention; and

5

6 Fig. 15a is a side elevation, partly in section, of a
7 thirteenth embodiment of the present invention and Fig.
8 15b is an exploded perspective view of components of
9 the wrench of Fig. 15a.

10

11 The embodiments of the invention will now be described
12 with reference to the drawings. In the various
13 embodiments and corresponding drawings, like reference
14 numerals will be used to indicate like features.

15

16 Referring now to Fig. 1 of the drawings, a wrench in
17 accordance with the invention includes a head portion
18 10 connected to a shaft or handle 12. The head portion
19 10 is in the form of a ring 14 intended to
20 substantially surround the peripheral surface of a
21 workpiece such as a nut, bolt or screw. In use, the
22 inner surface of the head 10 engages the peripheral
23 surface of the workpiece. Fig. 1 shows the wrench in
24 its "rest" condition, with no torque applied.

25

26 The ring 14 has a first, fixed end 16 connected to the
27 shaft 12 and a second, free end 18 which terminates
28 close to the first end 16 but which is not connected
29 thereto or to the shaft 12. In this embodiment, the
30 ring 14 is divided into segments 20a-f corresponding in
31 number to the number of faces of the peripheral surface
32 of the workpiece with which the wrench is intended to

1 be used, such that the inner surface of the ring 14 has
2 a generally polygonal configuration. Preferably, the
3 inner surface 22 of each segment 20a-f is generally
4 convex, such that the thickness of the ring 14 varies
5 around its circumference, being thinnest at the
6 junctions 24a-e between adjacent segments. Preferably
7 also, the junctions 24a-e are radiused (concave). The
8 free end 18 comprises part of the end segment 20f of
9 the ring 14.

10

11 The head 10 further includes a cam portion 26 located
12 radially outwards from the end segment 20f of the ring
13 14 and defining a first cam surface 28 adapted to co-
14 operate with a second cam surface 30 provided by the
15 outer surface of the end segment 20f of the ring 14.
16 The first cam surface 28 is preferably generally convex
17 and the second cam surface 30 is preferably generally
18 concave (such that the outer surface of the end segment
19 20f of the ring is configured as a decreasing ramp).
20 The first cam surface 28 may be provided by an insert
21 in the cam portion 26 such as a cylindrical pin or
22 roller 32. Adjacent the cam portion 26 there is
23 provided an abutment surface 34, generally parallel to
24 an end surface 36 of the free end 18 of the ring 14 and
25 spaced therefrom by a gap 38.

26

27 Figs. 2a to 2c show a set of dual-head wrenches 40
28 incorporating the head design illustrated in Fig. 1.
29 As in the case of conventional wrenches, wrenches in
30 accordance with the present invention may be provided
31 in a variety of sizes to suit standard workpiece sizes,
32 with single or dual heads. A dual-head wrench could

1 incorporate a first head in accordance with the
2 invention and a second conventional head.

3

4 Fig. 3b illustrates a nut 42 engaging a bolt 44, and
5 Fig. 3a shows the wrench of Fig. 1 engaging the nut 42.
6 It is common for the nuts, bolt heads etc to become
7 worn in use, so that the corners 46 of the nut between
8 its peripheral faces wear flat as shown in Fig. 3b.
9 The head of a conventional wrench will tend to slip
10 around a worn nut of this type.

11

12 When a wrench in accordance with the present invention
13 is engaged with a nut 6 as shown in Fig. 3a and a force
14 applied to the head in the direction of the arrow 48
15 (i.e. in the direction defined by the shortest distance
16 between the fixed end 16 and the free end 18 of the
17 ring) then, assuming that a certain minimal degree of
18 friction is generated between the inner surface of the
19 ring and the nut 42, the ring 14 will deform and tend
20 to close around the nut 42, progressively tightening
21 the grip between the ring 14 and the nut 42 and
22 preventing any slippage even if the nut 42 is
23 significantly worn, damaged or undersized.

24

25 In more detail, when torque is applied to the wrench in
26 the direction shown by the arrow 48, this causes the
27 first cam surface 28 to press against the second cam
28 surface 30, pushing the free end 18 of the ring 14
29 inwards towards the nut 42. The torque applied when
30 the shaft is first turned causes a force to be applied
31 radially inwards from the free end 18 onto the nut 42.
32 This force effectively wedges the free end 18 against

1 the nut 42. When further torque applied, the wrench
2 shaft and ring are pulled around in the direction 48
3 such that the cam moves along the second cam surface 30
4 in the direction shown by arrow 48. The shape of the
5 second cam surface 30 also means that the abutting
6 surface 36 of the end segment 20f of the ring 14 moves
7 towards the abutment 34, narrowing the gap 38.

8

9 In effect, the ring is being stretched from the
10 position of the last segment 20f which is secured
11 against the nut. The force transmitted around the ring
12 14 also acts to deform the ring at the segment
13 junctions 24a-e. The convex shape of inner surfaces 22
14 of the ring segments 20a-f also serve to enhance the
15 grip between the ring 14 and the peripheral surfaces of
16 the workpiece. Even if the workpiece is damaged, worn
17 or undersized, providing there is sufficient initial
18 contact and friction between the ring and the
19 workpiece, the ring 14 will deform inwards to provide
20 increased grip enabling further torque to be applied to
21 rotate the workpiece.

22

23 In the embodiments of Figs. 1 to 3, the junctions 24a-e
24 between adjacent segments 20a-f of the ring 14 provide
25 "integral hinges", allowing the ring to deform
26 elastically and close around the workpiece. The
27 surfaces 34 and 36 limit the deformation of the ring 14
28 when torque is applied in the direction of the arrow
29 48. However, if torque was applied in the opposite
30 direction (arrow 50 in Fig. 1), there is a risk that
31 the ring 14 would be damaged by being deformed
32 plastically.

1
2 Figs. 4a and 4b illustrate a further embodiment of the
3 invention which is similar to that of Fig. 1 except
4 that the head 10 includes means for preventing the ring
5 14 from opening excessively if the head 10 is rotated
6 in the direction indicated by the arrow 50. The free
7 end 18 of the ring 14 is provided with an outward
8 projection 52 which co-operates with a corresponding
9 recess 54 formed in the cam portion 26. In this
10 example, the insert 32 of Fig. 1 is omitted and the
11 first cam surface 28 is formed integrally with the cam
12 portion 26.

13
14 Fig. 5. illustrates a further embodiment similar to Fig.
15 1 and Fig. 2, with a different configuration of a catch
16 arrangement to prevent opening of the ring. In this
17 example, the free end 56 of the end segment 20f of the
18 ring 14 is extended and is accommodated by a notch or
19 channel 58 formed in the head portion 10 adjacent the
20 cam portion 26. The extended free end 56 and notch 58
21 co-operate to limit movement of the end segment 20f of
22 the ring 14 both in the direction of the arrow 48 and
23 in the direction of the arrow 50. Other equivalent
24 arrangements may be employed in these or any of the
25 other embodiments of the invention to limit movement of
26 the end segment 20f in either or both of the directions
27 48 and 50.

28
29 The embodiment of Fig. 5 again includes an insert 32
30 which provides the first cam surface 28 of the wrench.
31 It will be understood that an insert of this type may
32 be included in any of the embodiments of the invention,

1 or the first cam surface 28 may be formed as an
2 integral part of the head of the wrench in any of the
3 embodiments of the invention.

4

5 In the embodiments described thus far, the head of the
6 wrench comprises a substantially closed ring which, in
7 use, substantially surrounds the workpiece. As with
8 conventional ring-type wrenches, this arrangement means
9 that, in certain circumstances, it may be difficult or
10 impossible for the wrench to engage a particular
11 workpiece.

12

13 Figs 6a-6d illustrate a further embodiment of the
14 present invention in which the ring defined by the head
15 of the wrench is provided with a hinge or pivot 60,
16 enabling the ring 14 to be opened in order to engage a
17 workpiece. In this example, the hinge 60 is provided
18 at the junction 24a between first and second segments
19 adjacent the fixed end 16 of the ring 14. Fig. 6a
20 shows the ring closed, in position for use. Figs. 6b,
21 6c and 6d illustrate the use of the hinge 60 to open
22 the ring 14. This embodiment is particularly useful
23 where the ring 14 of the wrench is to be fitted around,
24 for example, a nut located on a length of pipe. The
25 hinge 60 allows the ring 14 to be opened out to allow
26 it to be easily fitted around the workpiece. This has
27 particular advantages over traditional closed ring
28 wrenches which cannot be used if the ring cannot be
29 fitted over the end of the pipe to be positioned on the
30 nut. Once in position, the wrench of the present
31 invention can be used to tighten or loosen the nut or
32 bolt as previously described.

1
2 Fig. 7 shows a wrench in accordance with the present
3 invention similar to that of Figs 6 a-d, but with an
4 integral first cam surface 28 rather than an insert. In
5 this example also, the convex inner surfaces 22 of the
6 ring segments 20a-f have less curvature than in the
7 embodiment of Fig.1. This provides a larger surface
8 area of contact between these surfaces and the surfaces
9 of the workpiece. In addition, the junctions 24a-e are
10 radiused so as to be substantially semicircular in
11 profile.

12
13 Fig. 8 shows further embodiment of a wrench in
14 accordance with present invention, similar to that of
15 Figs 6 a-d, but with a hinge provided by ball and
16 socket joint 62 which, in this example, is located
17 between the second and third ring segments 20b,20c.
18 Fig. 9 shows a wrench in accordance with the present
19 invention similar to that of Figs 6 a-d, with a knuckle
20 joint 64 providing a hinge between the first and second
21 ring segments 20a,20b. This embodiment is shown in its
22 working position, where a torque is to be applied in
23 the direction shown by arrow 48, such that the free end
24 18 of the ring 14 moves freely towards the abutment 34.
25 The extent of this free movement is determined by a gap
26 66 formed by the knuckle joint between the adjacent
27 ring segments 20a,20b. Once this gap 66 has been
28 closed, any additional torque will cause the ring 14 to
29 deform and the area inside the ring to decrease. The
30 abutment of the segments 20a,20b provides additional
31 leverage.

1 Figs. 10a, 10b and 10c show a wrench in accordance with
2 the present invention similar to that of Figs 6 a-d,
3 with an extended ball and socket joint 68 providing a
4 hinge between the second and third ring segments
5 20b,20c. This figure also shows the extent to which the
6 ring 14 may be opened to allow an object to be fitted
7 inside the ring. As with Fig. 9, the ring 14 moves
8 freely until an extension portion 71 of the ball and
9 socket joint 68, connected to the third ring segment
10 20c, abuts against the outer surface of the second ring
11 segment 20b. Thereafter, the area inside the ring is
12 decreased by deformation of the ring about the
13 junctions 24c-e between the segments 20c-f.

14

15 Figs. 11a, 11b and 11c illustrate a further embodiment
16 of the present invention in which pivot hinges 72 are
17 provided between each of the segments 20a-f of the ring
18 14.

19

20 In use, the wrench illustrated in Figs. 11a, 11b and
21 11c allows the ring 14 to be opened out as shown in
22 Fig. 11b because each of the segments is rotatable
23 about the hinges 72. This again allows the wrench to
24 be positioned around a nut or bolt located on a length
25 of pipe.

26

27 Whilst the above examples describe a ring inner surface
28 which is substantially hexagonal in shape, in its
29 working position, further examples of the present
30 invention are envisaged in which the inner surface is
31 triangular, square, pentagonal, heptagonal, octagonal,

1 nonagonal, decagonal or having a larger number of
2 sides.

3

4 Figs 12a-e illustrate a further embodiment of the
5 present invention in which the third and fourth ring
6 segments 20c,20d are hingeably connected by a chain
7 link 74. The term "chain link" as used herein means an
8 arrangement in which a plate member 76 having a figure-
9 of-eight configuration is disposed on either side of
10 the ring 14 and pivot pins 78 extend between the plates
11 76 through bores formed at the ends of the adjacent
12 ring segments 20c,20d. This is a preferred form of
13 hinge for use in accordance with the present invention
14 and may be employed to interconnect one or more pairs
15 of ring segments other than or in addition to the third
16 and fourth segments as shown in this embodiment. Fig.
17 12a shows the wrench in its working position (closed)
18 and Figs. 12b-e show the ring 14 progressively opening
19 from the working position. Figs. 12f to 12h illustrate
20 the chain link 74 in more detail. Fig. 12f is an
21 exploded view of the chain link 74, also including a
22 spring clip 79 which would normally be included in a
23 chain link of this type. Fig. 12g shows the ring 14
24 hinged open and Fig. 12h shows the ring 14 hinged
25 closed.

26

27 Figs. 13a and 13b show a further embodiment of the
28 invention, similar to that of Figs. 12a-e, in which the
29 chain link hinge 74 is provided with resilient bias
30 means comprising spring elements 80 which tend to urge
31 the ring 14 towards its normal closed, working
32 position, illustrated in Fig. 13a. The combination of

1 the hinge and resilient bias means generally provides a
2 junction between the adjacent ring sections connected
3 by the hinge 74 (segments 20c,20d in this preferred
4 example) which is more flexible than the "integral
5 hinges" provided by the junctions 24a,b,d,e between the
6 other pairs of adjacent segments. The use of such
7 resilient bias means that the wrench operates in a
8 substantially identical manner to that of the
9 embodiment of Fig. 1 when rotated in the direction 48.
10 However, when rotated in the opposite direction 50, the
11 resilient bias means associated with the hinge 74
12 allows the ring 14 to open slightly so that the ring 14
13 may rotate relative to the workpiece, thereby providing
14 a type of ratchet mechanism so that the wrench does not
15 need to be removed from the workpiece between
16 successive strokes in the "working direction" 48. The
17 bias means allows the ring to rotate relative to the
18 workpiece on the return stroke, and urges the ring
19 segments back into their working position for the next
20 working stroke.

21
22 In this example, the spring elements 80 are formed
23 integrally with the plates 76 of the chain link 74,
24 comprising resilient arms 82 which extend from either
25 end of the plates 76, curving in the plane of the
26 plates 76 around the outer ends thereof, and having end
27 portions 84 which are bent out of the plane of the
28 plates 76. When the plates 76 are located on either
29 side of the ring segments 20c,20d, the end portions 84
30 of the arms 82 project into and engage with apertures
31 86 formed in the side faces of the adjacent ring
32 segments 20c,20d.

1

2 The ring 14 may be opened against the return force of
3 the spring elements 80 as seen in Fig. 13b, allowing
4 the wrench to engage, for example, a nut located on a
5 length of pipe, as in the previous embodiments of the
6 invention incorporating hinged rings.

7

8 It will be understood that different types of resilient
9 bias means may be incorporated into chain link hinges
10 of the type employed in the embodiments of Figs. 12 and
11 13, or into other types of hinges.

12

13 Fig 14 shows a further embodiment of the present
14 invention in which the inside surface of the ring 14 is
15 substantially circular, rather than polygonal. The
16 inner surface of the ring 14 is provided with
17 corrugations or serrations 90 which grip the workpiece
18 inside the ring on application of a torque. The ring
19 14 as a whole is sufficiently flexible to deform and
20 close around the workpiece. The size, shape and
21 distribution of the corrugations 90 will depend on the
22 nature of the intended workpiece. This embodiment may
23 also be modified to incorporate variations of the cam
24 surfaces, stops and catches, hinges etc. described in
25 relation to previous embodiments. Also, the segmented
26 rings of previous embodiments may be provided with
27 serrations or corrugations on their inner surfaces.

28

29 Figs. 15a and 15b show a further alternative embodiment
30 of a wrench in accordance with the present invention,
31 again comprising a assembly 110 and a shaft 112.

32

1 In this embodiment, the head 110 comprises a ring
2 assembly 114 which consists of a generally V-shaped
3 member 200, the inner surfaces which define first and
4 second segments 120a and 120b of the ring, and a
5 plurality of discrete segments 120c-f. The V-shaped
6 member 200 and the segments 120c-f are interconnected
7 by an elongate, substantially inelastic, flexible
8 member 202, such as a strap or the like (suitably
9 formed from metal, plastics, leather or textile
10 material) which is threaded through the segments 120c-
11 f. The head 110 further includes a yoke portion 204
12 formed at the upper end of the shaft 112. The V-shaped
13 member is pivotably mounted in the yoke portion 204 by
14 means of a pivot pin 206 which extends through yoke
15 apertures 208 and complementary apertures 210 formed
16 adjacent the apex of the V-shaped member 200.

17
18 The outer surface of the V-shaped member 200 is formed
19 with a channel 212, defining a saddle surface 214
20 extending between two lug portions 216 which contain
21 the apertures 210. The strap 202 has first and second
22 free ends 202a and 202b. The first free end 202a of
23 the strap 202 extends from the segment 120f, passes
24 around one half of the saddle surface 214 opposite the
25 segment surface 120a, over the top of, around and under
26 the pivot pin 206, and out of the front of the yoke
27 portion 204. The second free end 202b of the strap 202
28 extends from the segment 120c, passes around
29 the second half of the saddle surface 214 opposite the
30 segment surface 120b, under the first free end 202a and
31 the pivot pin 206, and out of the front of the yoke
32 portion 204. Both of the free ends 202a and 202b are

1 secured to the front of the yoke portion 204 by any
2 suitable means such as rivets 218 engaging apertures
3 220.

4

5 In use, the ring assembly 114 is placed over the
6 workpiece. When torque is applied to the yoke 204 in
7 the direction of the arrow 148, the yoke 204 pivots
8 relative to the V-shaped member 200, pulling on the
9 second free end 202b of the strap 202 so that the trap
10 202 is pulled through the segments 120c-f, closing the
11 ring 114 about the workpiece by decreasing the
12 circumference of the head ring 114 and tightening the
13 grip of the ring 114 around the workpiece. Further
14 torque applied to the shaft allows the workpiece to be
15 rotated with the head of the wrench.

16

17 It will be appreciated that the extent of tightening of
18 the strap per unit angle through which the shaft has
19 been turned in the direction of arrow 148 is dependent
20 upon the circumference of the pivot pin 206. A larger
21 pin circumference will tighten the strap by turning the
22 shaft through a smaller angle than would be required
23 where the pin circumference is smaller.

24

25 If torque is applied opposite to the direction of the
26 arrow 148, the angle between the head and the shaft is
27 changed such that the strap is loosened to allow the
28 head 122 to be fitted over larger workpieces. The
29 wrench 100 is operated as before, by turning the shaft
30 in the direction of arrow 124. This embodiment
31 therefore provides additional flexibility by allowing
32 the wrench to be used on differently sized work pieces

1 depending on the initial angle between the shaft and
2 the head. The arrangement may also allow the ring 114
3 to ratchet about the workpiece on return strokes
4 between working strokes, as previously described in
5 relation to other embodiments of the invention.

6

7 Improvements and modifications may be incorporated
8 without departing from the scope of the invention as
9 defined in the Claims appended hereto.

1 CLAIMS

2

3 1. A wrench having a head portion (10,110) adapted to
4 engage and apply torque to a workpiece (42), said head
5 portion (10,110) including a flexible ring portion
6 (14,114) having an inner working surface for engaging
7 the workpiece (42), such that, when a torque is applied
8 to said head (10,110) in a predetermined direction
9 (48,148), said ring portion closes around said
10 workpiece (42).

11

12 2. A wrench as claimed in Claim 1 having a head
13 portion (10) adapted to engage and apply torque to a
14 workpiece (42), said head portion (10) including a ring
15 member (14) adapted to substantially surround a
16 peripheral surface of a workpiece (42) and having a
17 first, fixed end (16) and a second, free end (18) such
18 that, when an inner surface of said ring member (14)
19 engages a workpiece (42) and a torque is applied to
20 said head portion (10) in a predetermined direction
21 (48), said ring member (14) closes around said
22 workpiece (42).

23

24 3. A wrench as claimed in Claim 2, wherein said
25 wrench further includes a first cam surface (28)
26 disposed adjacent an outer surface (30) of a free end
27 portion of said ring (14) such that, when said inner
28 surface of said ring member (14) engages said workpiece
29 (42) and said torque is applied to said head portion
30 (10) in said predetermined direction (48), said first
31 cam surface presses against said outer surface (30) of
32 said free end portion of said ring (14).

1

2 4. A wrench as claimed in Claim 3, wherein said first
3 cam surface (28) is generally convex.

4

5 5. A wrench as claimed in Claim 3 or Claim 4, wherein
6 said outer surface (30) of said free end portion is
7 generally concave.

8

9 6. A wrench as claimed in any one of Claims 3 to 5,
10 wherein said first cam surface (28) is formed
11 integrally with said wrench.

12

13 7. A wrench as claimed in any one of Claims 3 to 5,
14 wherein said first cam surface (28) is provided by an
15 insert (32).

16

17 8. A wrench as claimed in any any one of Claims 2 to
18 7, wherein said ring member (14) comprises a plurality
19 of segments (20a-f).

20

21 9. A wrench as claimed in Claim 8, wherein said
22 segments (20a-f) define a generally polygonal inner
23 surface of said ring member (14).

24

25 10. A wrench as claimed in Claim 8 or Claim 9, wherein
26 each of said segments (20a-f) has an inner surface
27 which is generally convex in the circumferential
28 direction of said ring member (14).

29

30 11. A wrench as claimed in any one of Claims 8 to 10,
31 wherein at least some of said segments (20a-f) are
32 formed integrally with one another and said ring member

1 (14) is adapted to deform resiliently at junctions
2 (24a-e) between adjacent, integrally formed segments.

3

4 12. A wrench as claimed in Claim 11, wherein said
5 junctions (24a-e) between adjacent, integrally formed
6 rings have a reduced thickness in the radial direction
7 as compared with the remainder of said segments (20a-
8 f).

9

10 13. A wrench as claimed in Claim 12, wherein said
11 junctions (24a-e) comprise portions of the inner
12 surface of said ring member which are generally concave
13 in the circumferential direction of said ring member
14 (14).

15

16 14. A wrench as claimed in any one of Claims 2 to 13,
17 wherein the inner surface of said ring member is
18 corrugated.

19

20 15. A wrench as claimed in any one of Claims 2 to 14,
21 wherein said head portion (10) includes means for
22 limiting movement of said free end (18) of said ring
23 member (14) relative to said fixed end (16) thereof in
24 said predetermined direction (48).

25

26 16. A wrench as claimed in any one of Claims 2 to 15,
27 wherein said head portion (10) includes means for
28 limiting movement of said free end (18) of said ring
29 member (14) relative to said fixed end (16) thereof in
30 a direction (50) opposite to said predetermined
31 direction (48).

32

1 17. A wrench as claimed in any one of Claims 2 to 16,
2 wherein said head portion (10) includes hinge means
3 (60, 62, 64, 68, 72, 74) whereby at least a portion of
4 said ring member (14) may be pivoted in the plane of
5 said ring member (14) relative to the remainder of said
6 head portion (10).

7

8 18. A wrench as claimed in Claim 17, wherein said ring
9 member comprises a plurality of segments (20a-f) and
10 wherein said hinge means (60, 62, 64, 68, 72, 74) is
11 located between at least one pair of adjacent segments
12 (20a-f).

13

14 19. A wrench as claimed in Claim 16 or Claim 17,
15 including resilient bias means (80) associated with
16 said hinge means (60, 62, 64, 68, 72, 74) and adapted
17 to bias said ring member towards a closed position.

18

19 20. A wrench as claimed in Claim 1, wherein said ring
20 portion (114) is pivotably connected to a yoke portion
21 (204) of said head (110) and comprises a plurality of
22 segments (120a-f) interconnected by an elongate
23 flexible member (202) having first and second free ends
24 (202a,b) secured to said yoke portion (204) such that
25 pivoting movement of said ring (114) relative to said
26 yoke (204) in a predetermined direction (148) causes a
27 length of said elongate flexible member (202) passing
28 around said ring (114) to be shortened and the ring
29 (114) to close.

30

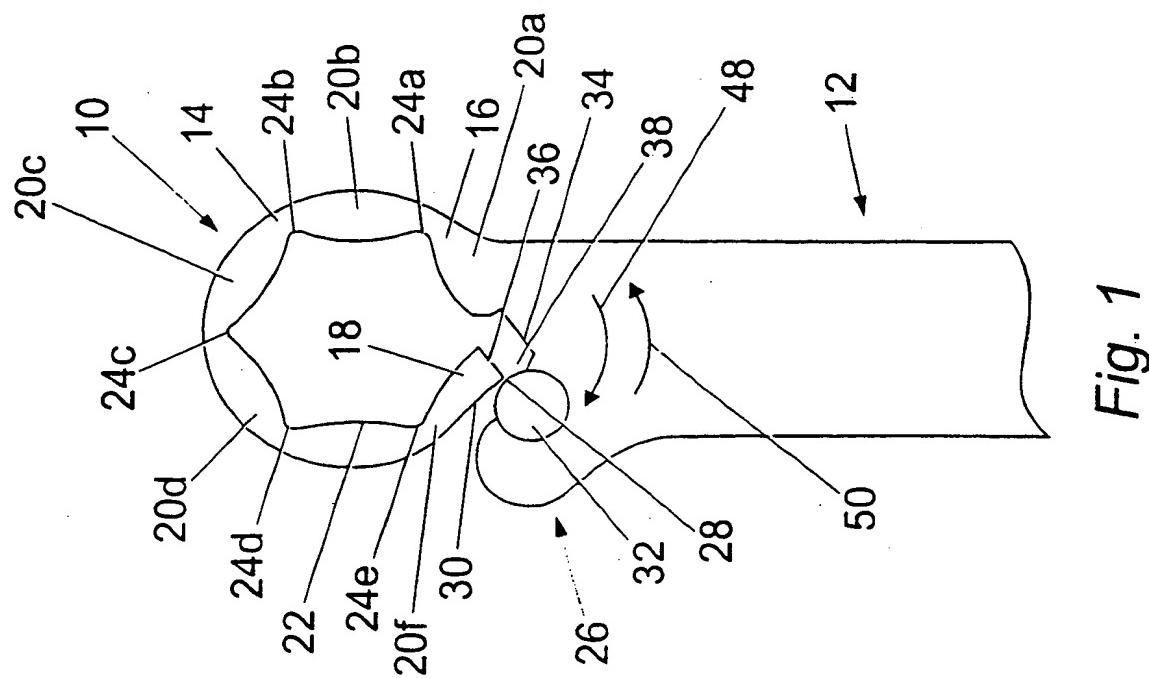
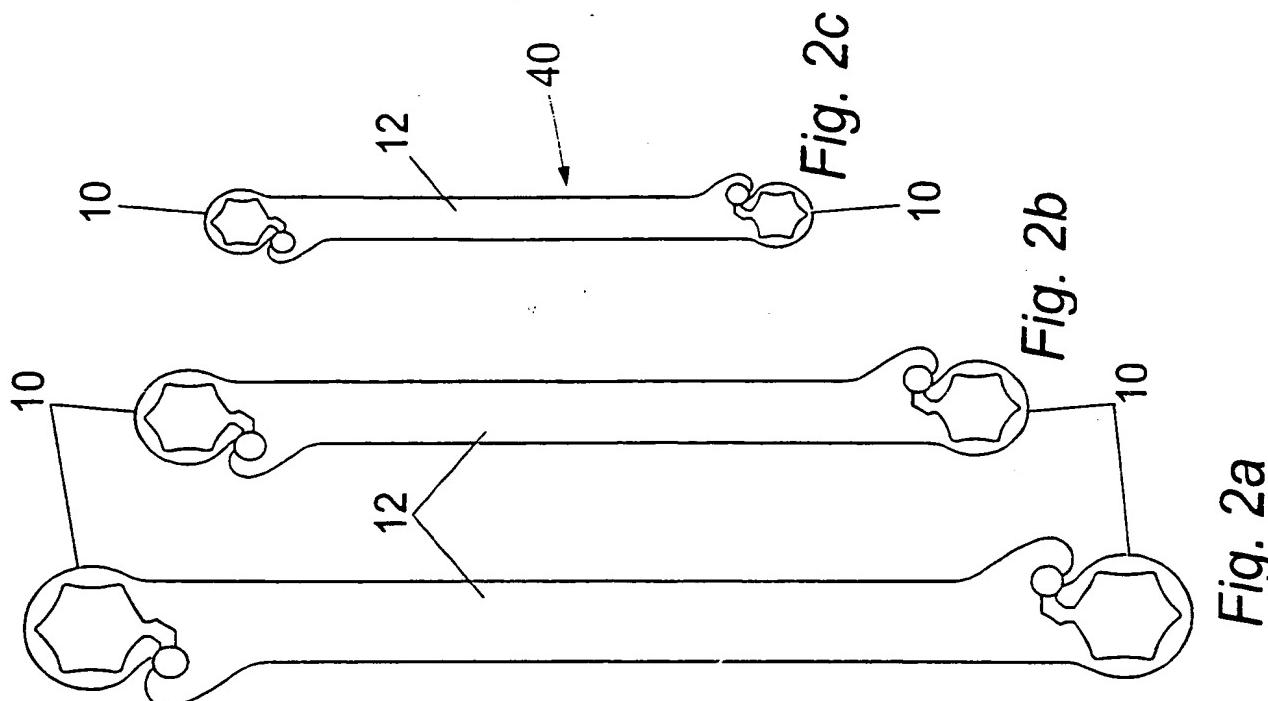
31 21. A wrench as claimed in claim 20, wherein first and
32 second segments (120a,b) of said ring (114) are formed

1 integrally with one another as part of a pivot member
2 (200) pivotably mounted in said yoke (204) by means of
3 a pivot pin (206) and the remainder of said segments
4 (120c-f) are formed as discrete members, said flexible
5 elongate member being threaded through said remainder
6 of said segments (120c-f) and the free ends (202a,b)
7 thereof passing around an outer surface (214) of said
8 pivot member and around said pivot pin (206).
9

10 22. A wrench as claimed in Claim 21, wherein the first
11 free end (202a) of the flexible elongate member (202)
12 extends from one of said discrete segments (120f),
13 passes around one part of said outer surface (214) of
14 said pivot member (200) opposite an inner surface
15 thereof defining a first segment (120a), over the top
16 of, around and under the pivot pin (206), and out of
17 the front of the yoke portion (204), and wherein the
18 second free end (202b) of the elongate flexible
19 member (202) extends from another of said discrete
20 segments (120c), passes around a second part of said
21 outer surface (214) of the pivot member (200) opposite
22 an inner surface thereof defining a second segment
23 (120b), under the first free end (202a) and the pivot
24 pin (206), and out of the front of the yoke portion
25 (204).

THIS PAGE BLANK (USPTO)

1 / 12



THIS PAGE BLANK (USPTO)

2 / 12

Fig. 3b

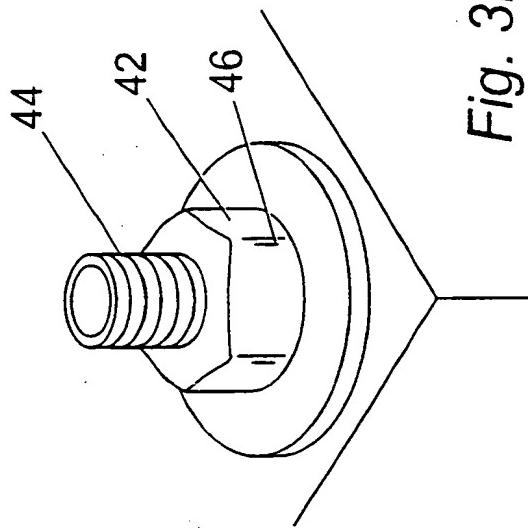
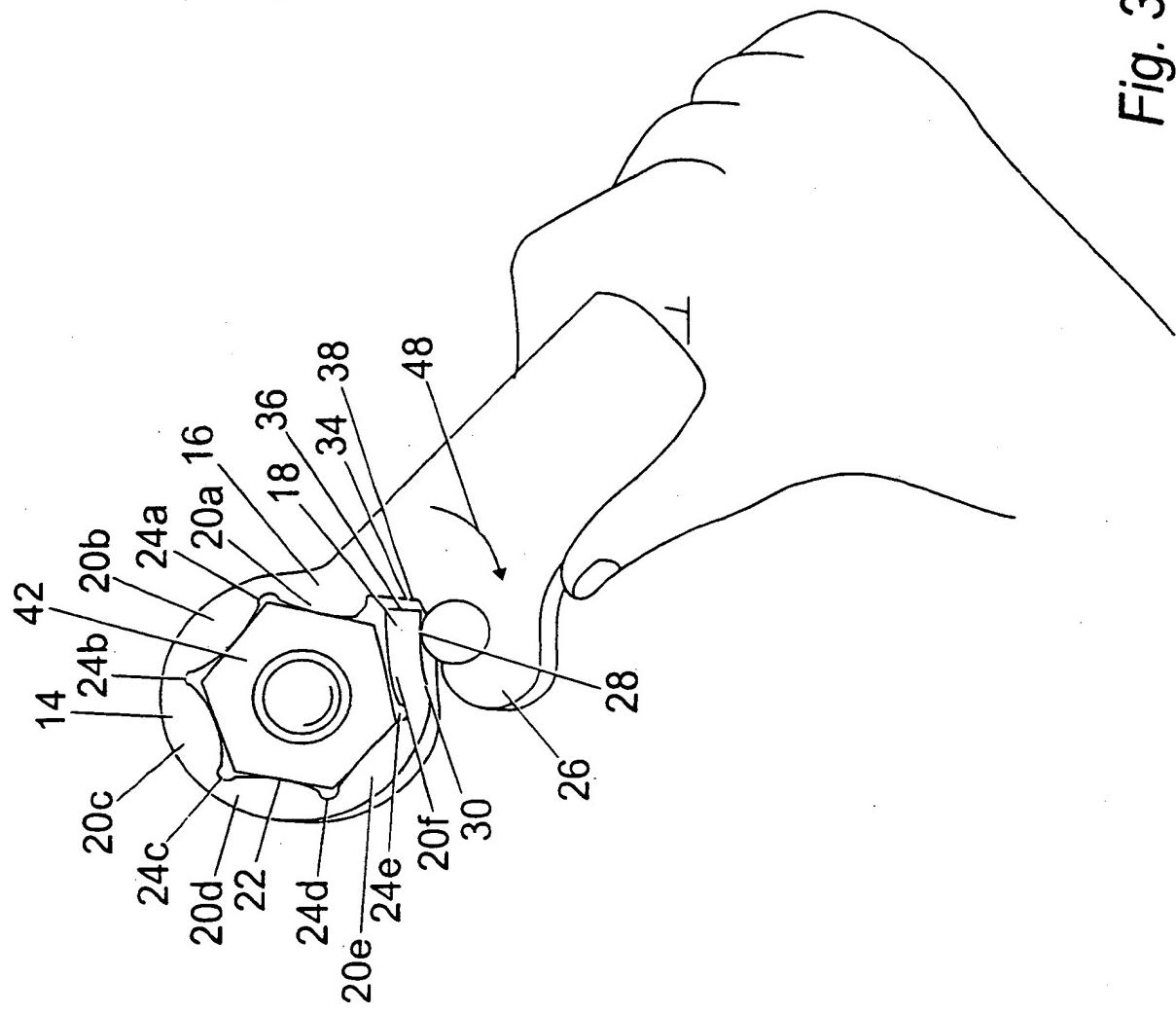
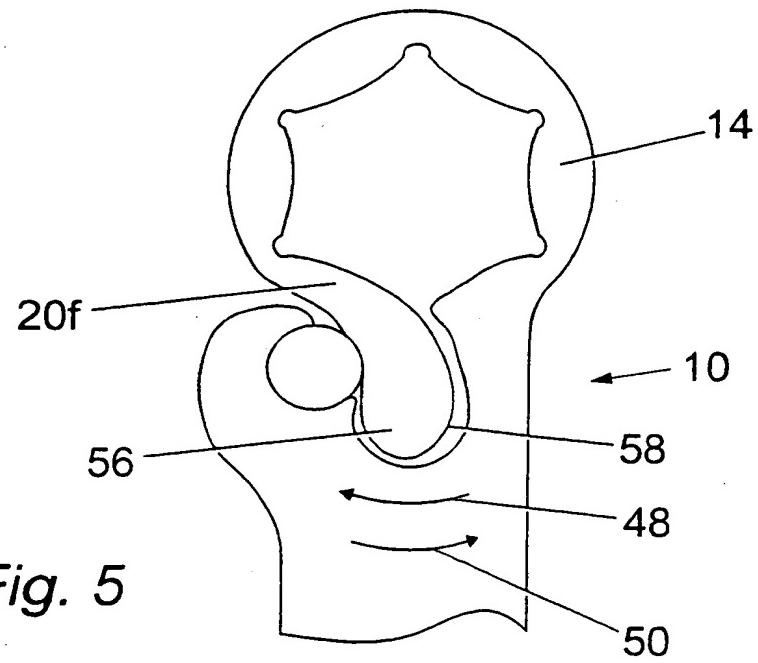
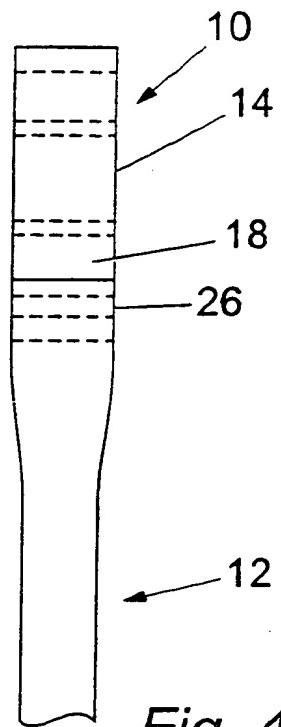
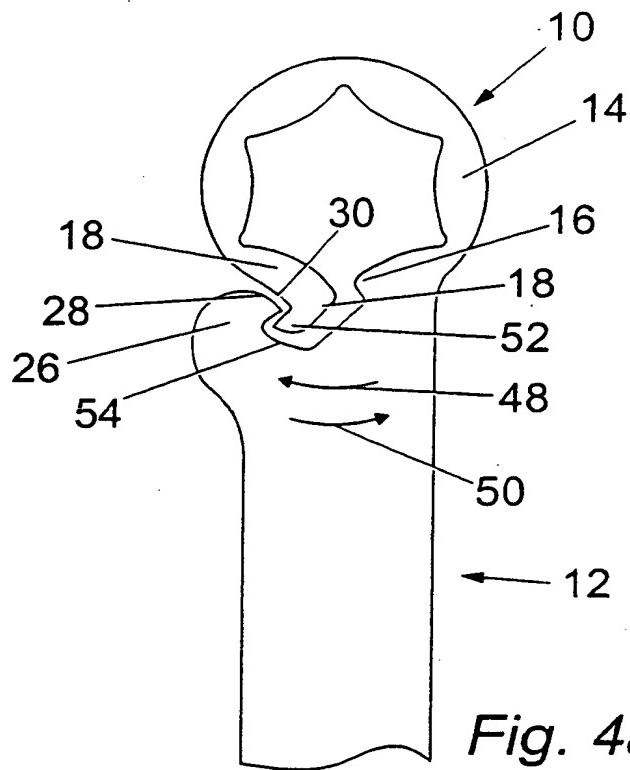


Fig. 3a



THIS PAGE BLANK (USPTO)

3 / 12



THIS PAGE BLANK (USPTO)

4 / 12

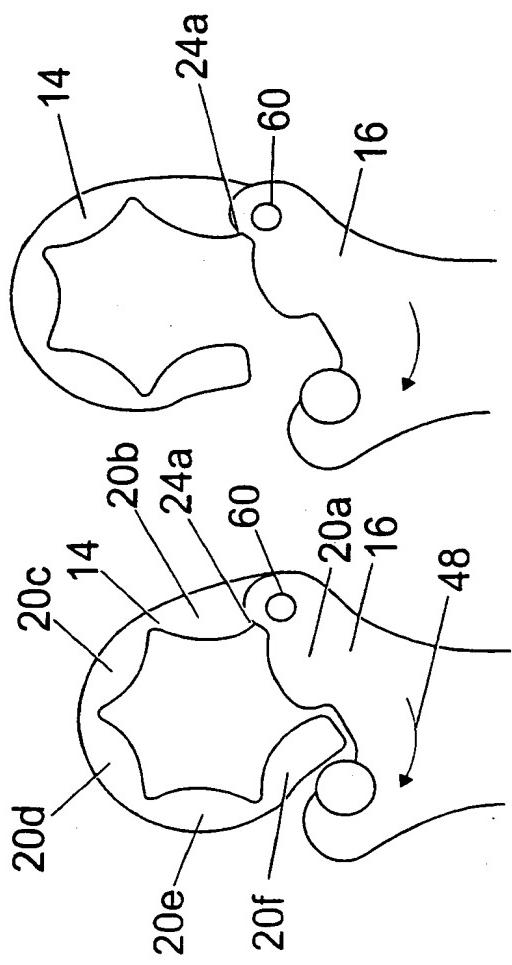


Fig. 6b

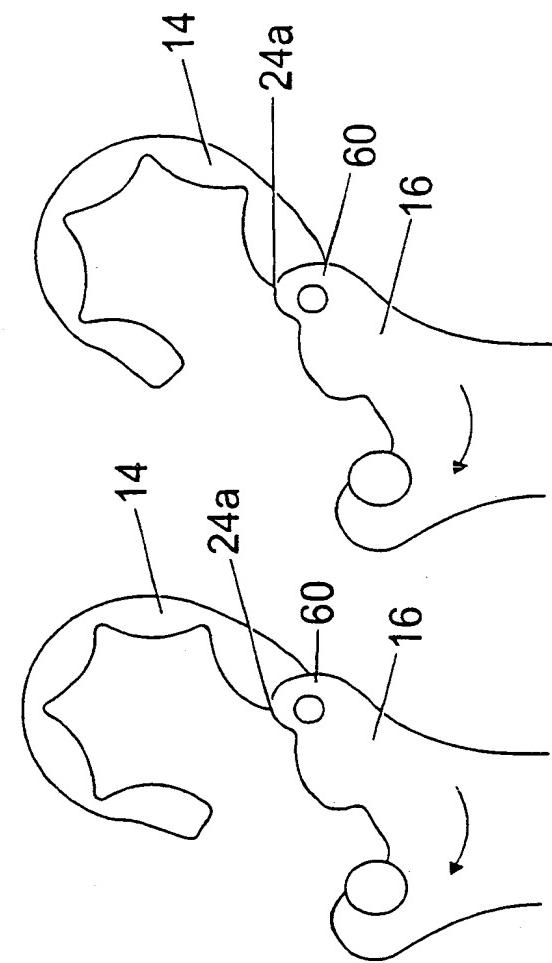


Fig. 6c

Fig. 6d

THIS PAGE BLANK (USPTO)

5 / 12

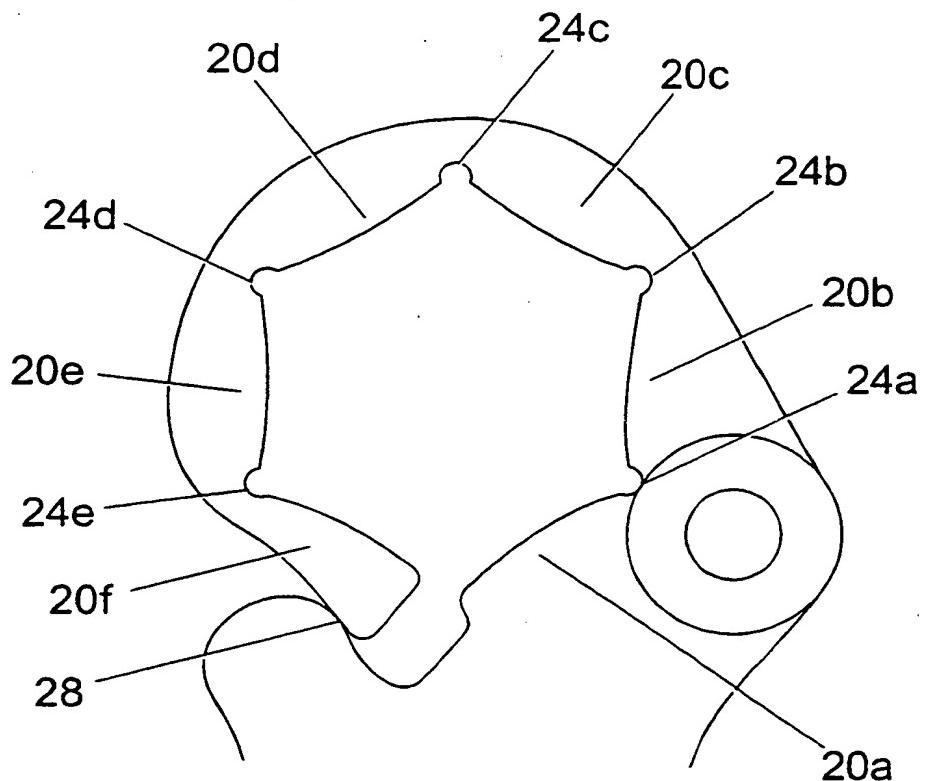


Fig. 7

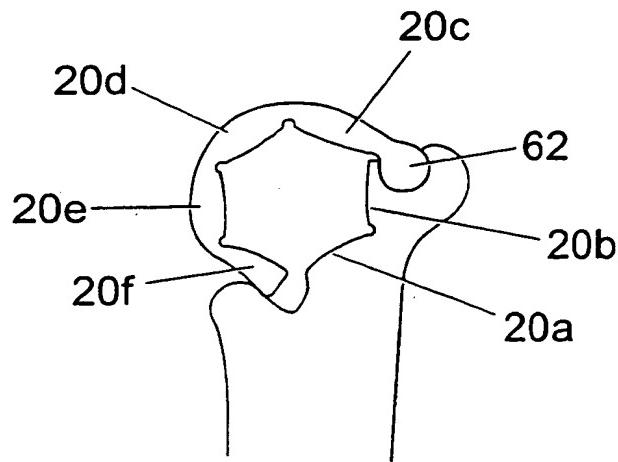


Fig. 8

THIS PAGE BLANK (USPTO)

6 / 12

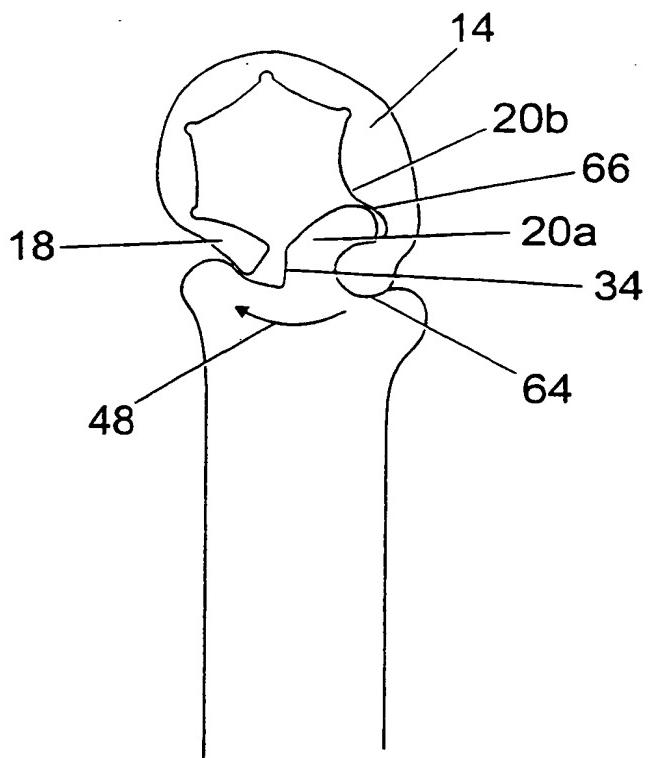


Fig. 9

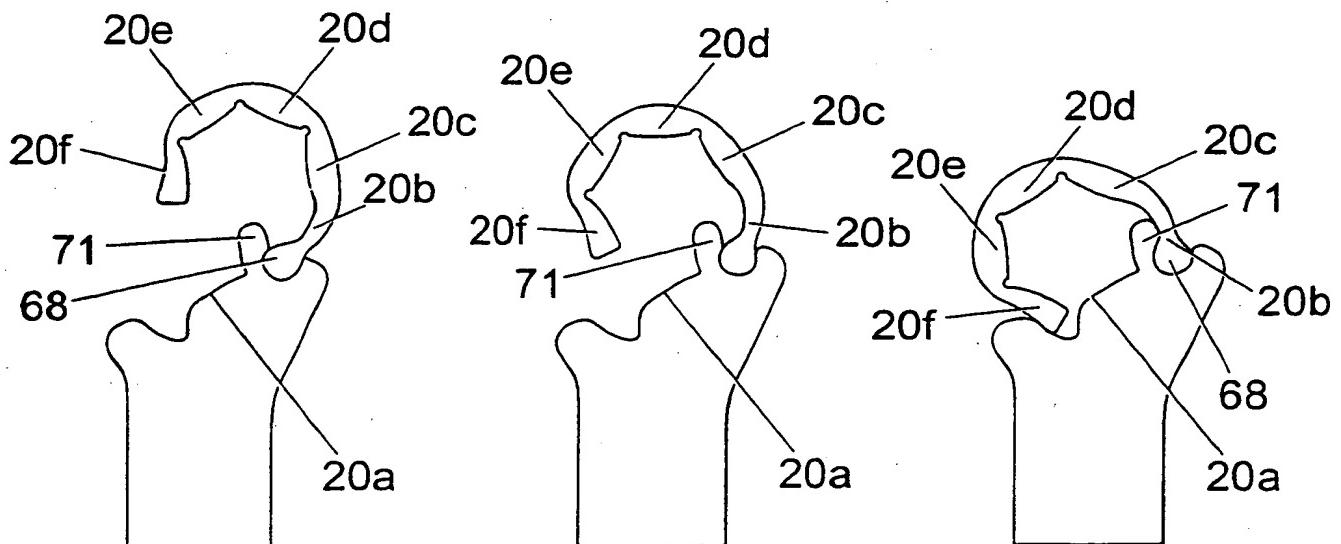


Fig. 10a

Fig. 10b

Fig. 10c

THIS PAGE BLANK (USPTO)

7 / 12

14

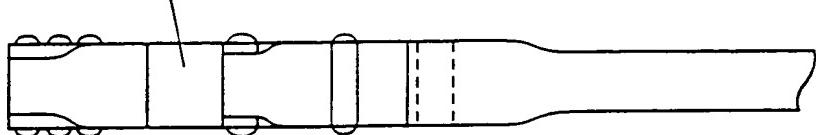


Fig. 11c

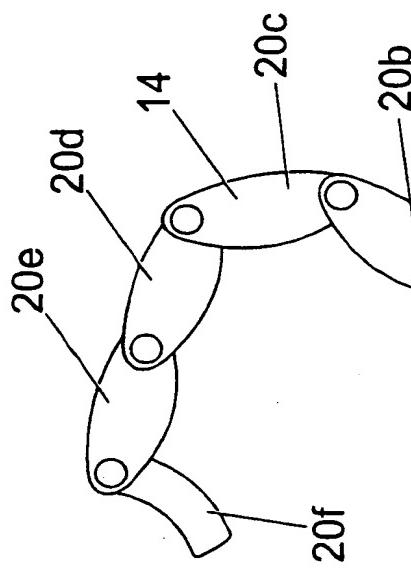


Fig. 11b

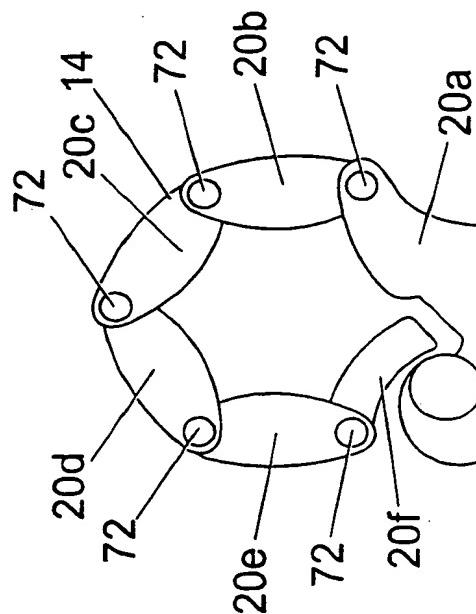


Fig. 11a

JC05 Rec'd PCT/PTO 01 OCT 2007

THIS PAGE BLANK (USPTO)

8 / 12

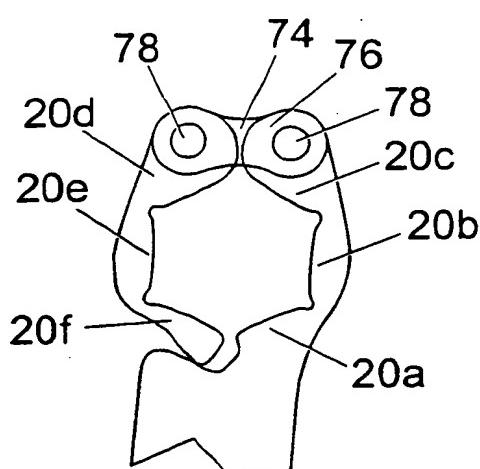


Fig. 12a

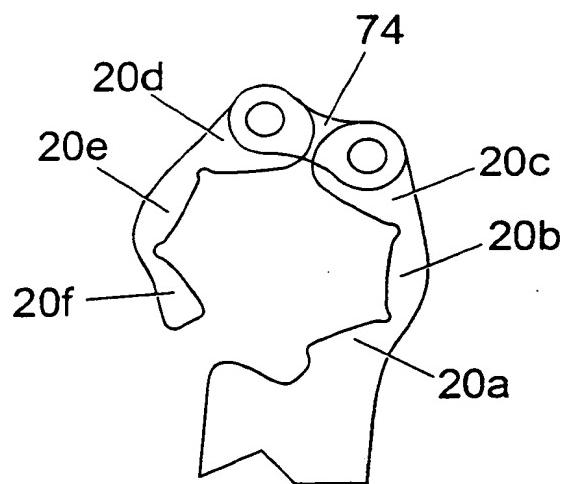


Fig. 12b

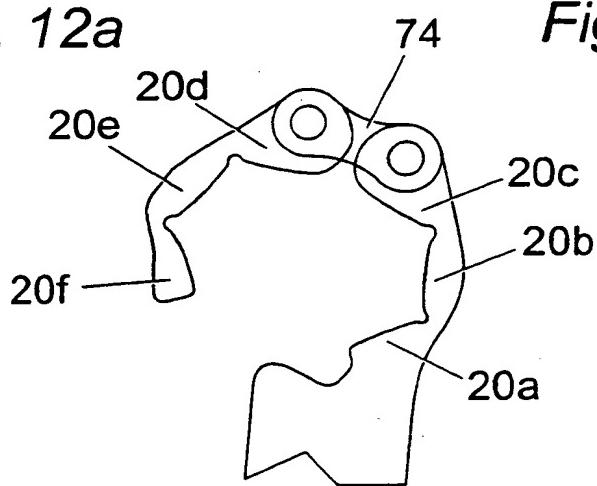


Fig. 12c

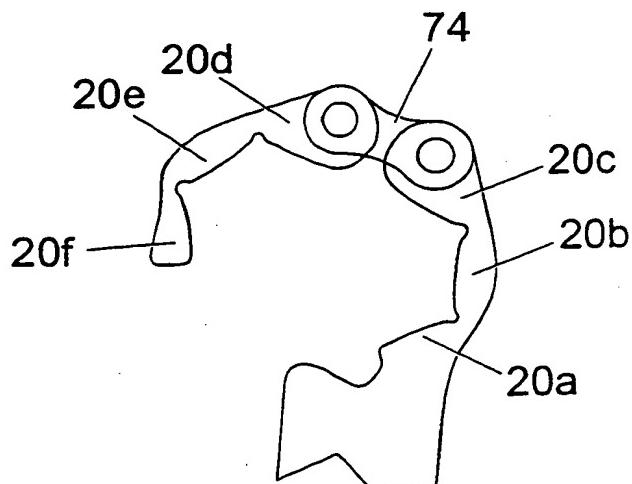


Fig. 12d

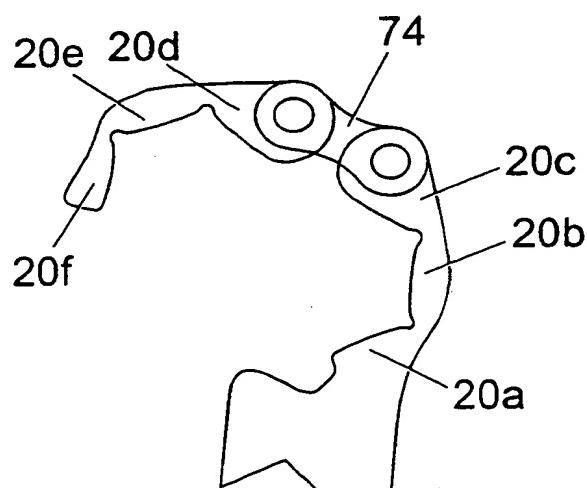
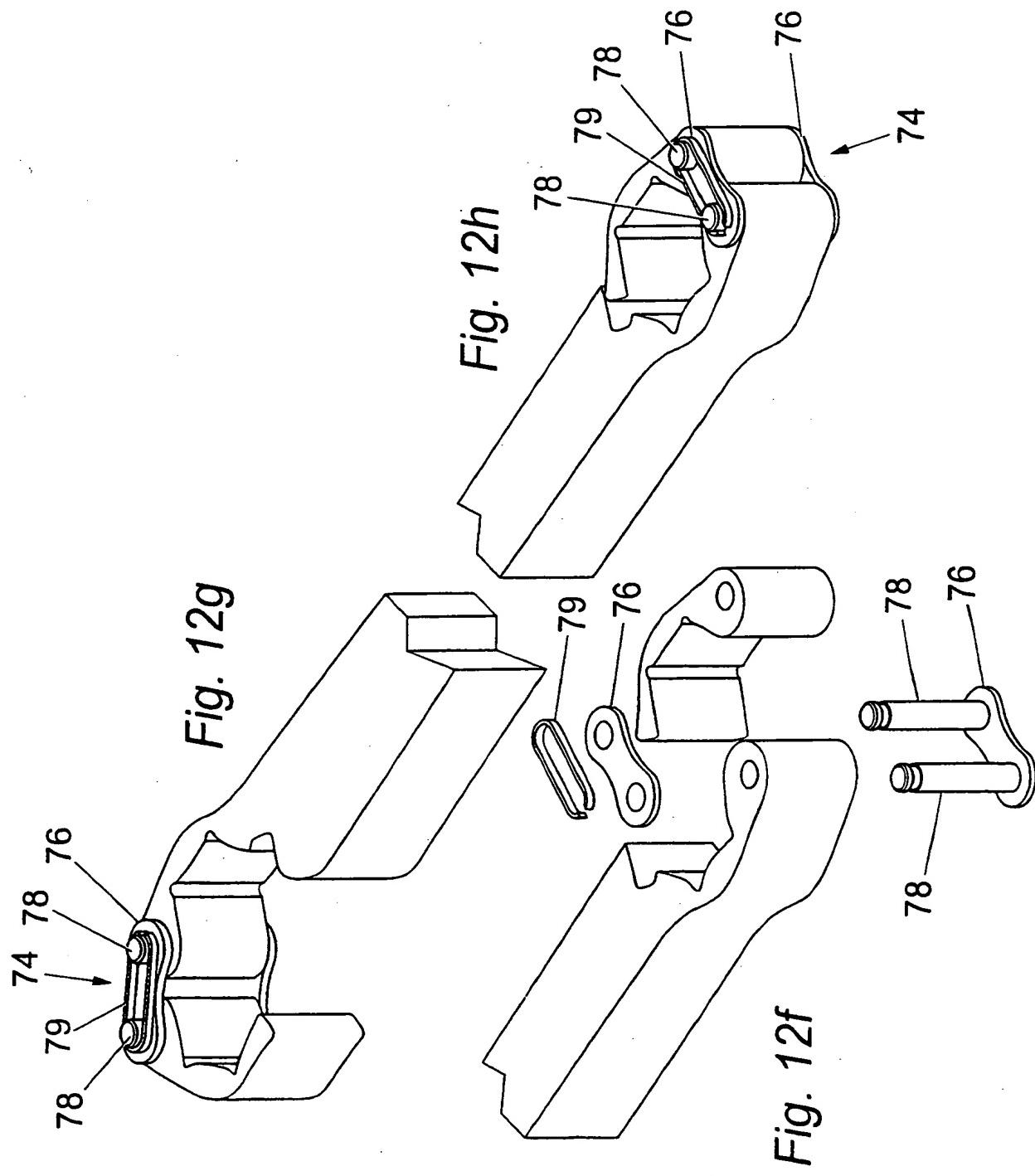


Fig. 12e

THIS PAGE BLANK (USPTO)

9 / 12



JC05 Rec'd PCT/PTO 01 OCT 2001

THIS PAGE BLANK (USPTO)

10 / 12

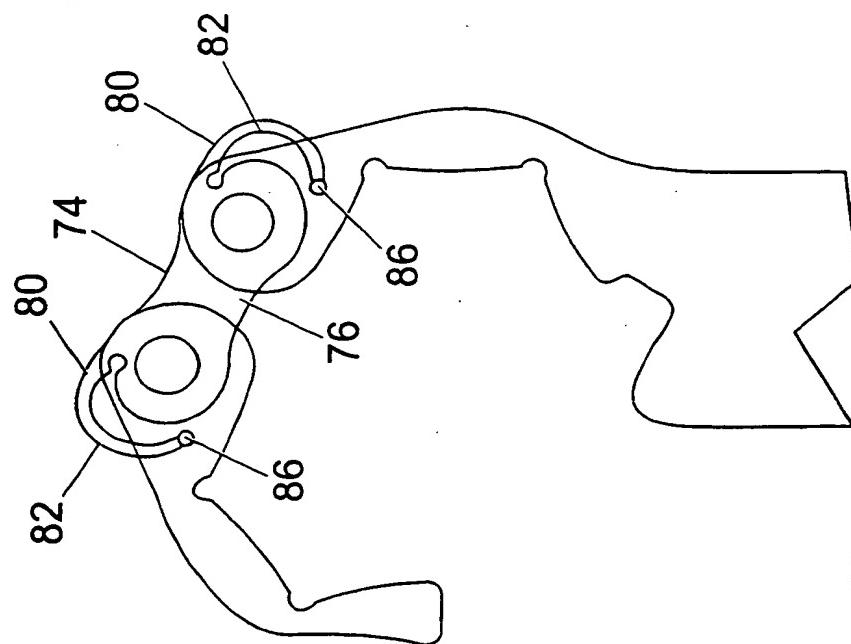


Fig. 13b

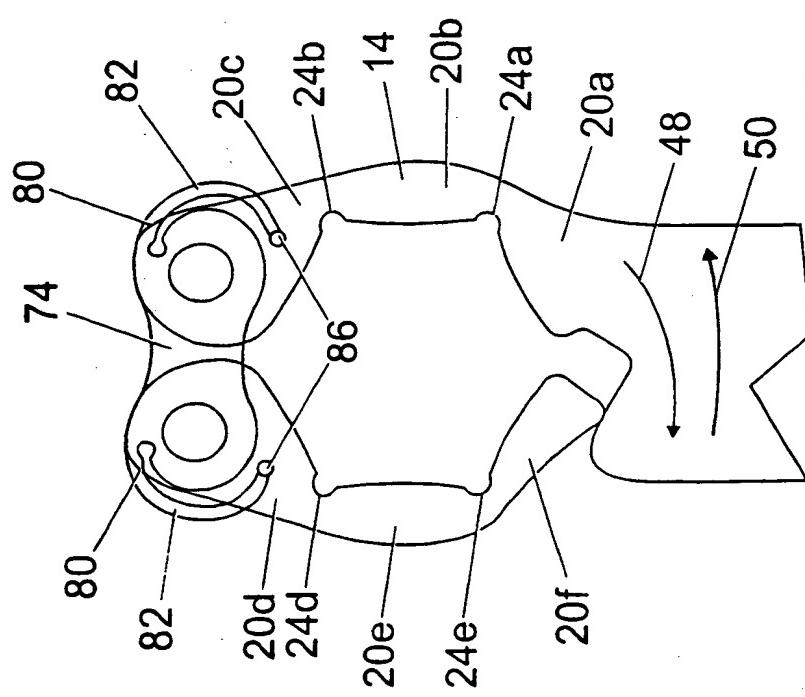


Fig. 13a

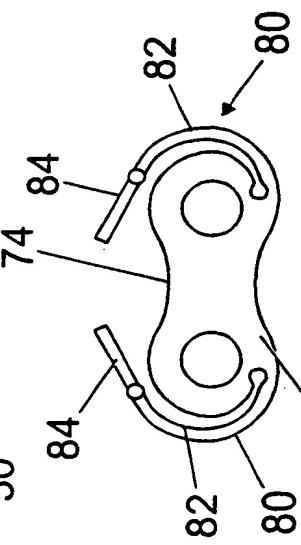


Fig. 13c

THIS PAGE BLANK (USPTO)

11 / 12

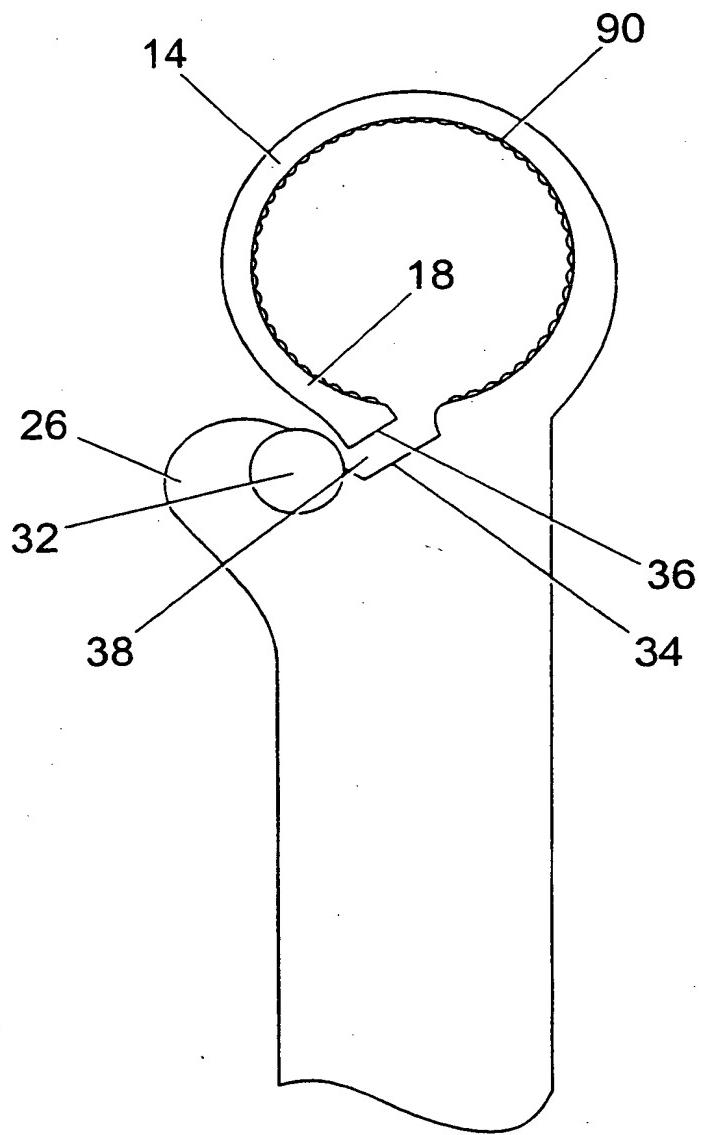


Fig. 14

THIS PAGE BLANK (USPTO)

12 / 12

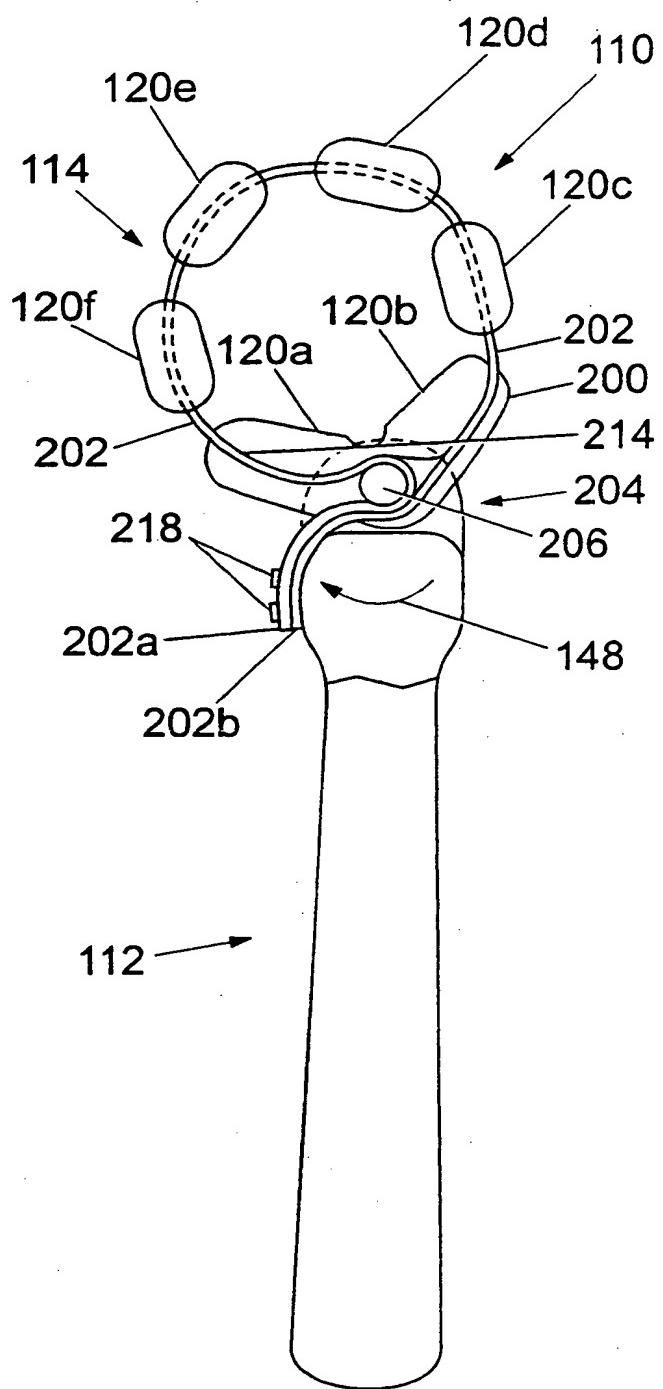


Fig. 15a

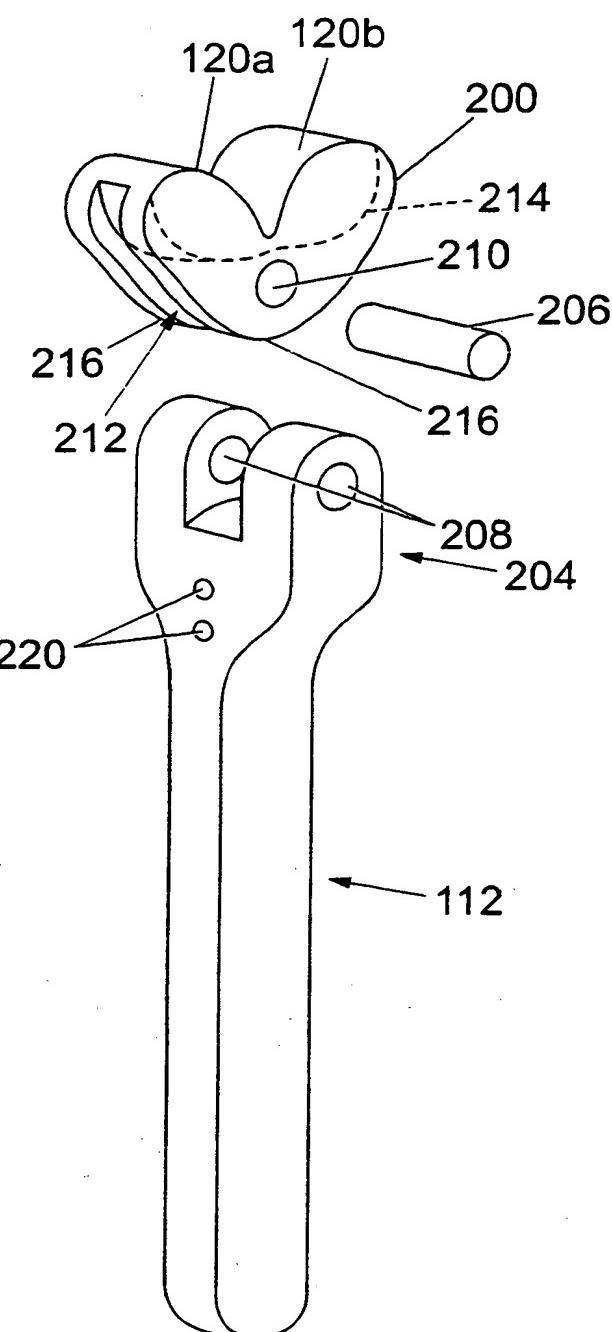


Fig. 15b

THIS PAGE BLANK (USPTO)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/01204

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B25B13/52 B25B13/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B25B B67B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 967 612 A (R.SPARLING) 6 November 1990 (1990-11-06) column 3, line 8 - line 29; claim 1; figures ---	1-3,6,8, 9,11,12, 17
X	US 2 435 329 A (D.M.STAINPROOK) 3 February 1948 (1948-02-03) column 1, line 50 -column 2, line 34; figure 1 ---	1-4,6,8, 17,18
X	DE 16 03 767 A (DAIMLER-BENZ AG) 18 February 1971 (1971-02-18) figure 1 ---	1,2,8-10
X	US 1 464 128 A (L.COES) 7 August 1923 (1923-08-07) claims; figures ---	1,2 -/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

12 July 2000

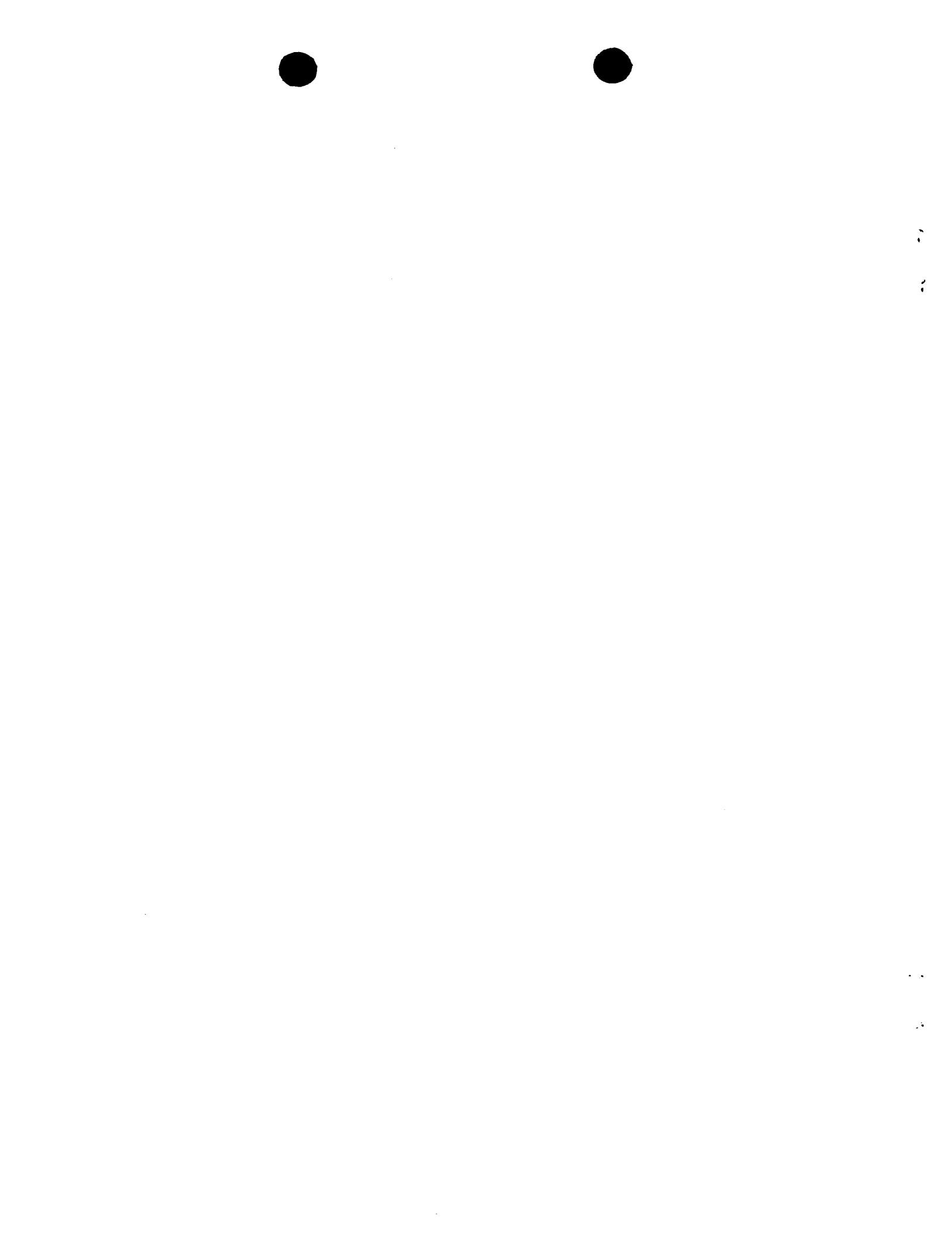
20/07/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Majerus, H



INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/01204

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 1 666 353 A (A.C.SCHELF) 17 April 1928 (1928-04-17) page 1, line 94 -page 2, line 2; figure 1 ---	14, 20, 21
A	GB 235 434 A (A.I.MANCHO) 9 July 1925 (1925-07-09) page 1, line 55 - line 65; figure 1 ---	19
A	US 1 610 387 A (J.E.PENNINGTON) 14 December 1926 (1926-12-14) page 1, line 73 - line 77; figure 1 -----	14, 20

THIS PAGE BLANK (USPTO)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/01204

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4967612	A 06-11-1990	NONE	
US 2435329	A 03-02-1948	NONE	
DE 1603767	A 18-02-1971	NONE	
US 1464128	A 07-08-1923	NONE	
US 1666353	A 17-04-1928	NONE	
GB 235434	A	NONE	
US 1610387	A 14-12-1926	NONE	

THIS PAGE BLANK (USPTO)